ARTIFICIAL INTELLIGENCE: EMERGING OPPORTUNITIES AND ASSOCIATED CHALLENGES

NISHANT GUPTA

INTRODUCTION

In August 2020, Heron Systems won the Alpha Dogfight Challenge for their AI (Artificial Intelligence) algorithm beating a human fighter pilot in a virtual dogfight. It was the culmination of a yearlong US military aviation project under DARPA (Defence Advanced Research Project Agency) wherein eight select firms with various backgrounds had participated including large, traditional defence contractors like Lockheed Martin. The primary aim of the project was to "demonstrate the feasibility of developing effective, intelligent autonomous agents capable of defeating adversary aircraft in a dogfight". The victory of Heron Systems suggests that small and agile companies with young, fertile, innovative and flexible minds have greater potential to harness the disruptive technologies through their algorithms vis-à-vis large defence contractors having known or unknown biases.

For a long time, Softwares have been assisting humanity in the decision-making process by making fast and accurate calculations and assisting in interpretation of humungous data at a great speed, but AI, one of the vital verticals of the Fourth Industrial Revolution, is taking algorithms to an entirely different level, fast making inroads in almost every sphere of

Group Captain **Nishant Gupta**, Ph.D in Environmental Security and author of a book on IAF, is presently posted to Directorate of Education at Air Headquarters, New Delhi.

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The disruptive technologies are maturing and changing the world at an unprecedented pace. Fictions of yesteryear are increasingly turning into reality. We appear to be moving towards a world wherein future would only be limited by constraints of ideas, and not by technology. Race for developing AI enabled technology could be as disruptive as the nuclear arms race of the 20th century. This research paper is an attempt to understand AI and the emerging challenges it is likely to pose in the near future.

UNDERSTANDING AI

As per Klaus Schwab, the founder and executive Chairman of the World Economic Forum (which he began in 1971), the world is witnessing the beginning of the Fourth Industrial Revolution. The first industrial revolution spanned from about 1760 to around 1840 with initiation of the construction of railroads and the invention of the steam engine, which ushered in mechanical production. The second industrial revolution, fostered by the advent of electricity and the assembly line, enabled mass production from the late 19th century to the early 20th century. The third industrial revolution began in the 1960s. It is usually called the computer or digital revolution because it was catalysed by the development of semiconductors, mainframe computing (1960s), personal computing (1970s and 1980s) and the internet (1990s).[1] Building on the widespread availability of digital technologies that

1. Klaus Schwab, *The Fourth Industrial Revolution* (New York: Crown Publishing Group, 2017).

were the result of the Third Industrial—or Digital—Revolution, the Fourth Industrial Revolution will be driven largely by the convergence of digital, biological, and physical innovations. The unfolding of Fourth Industrial Revolution would hinge upon certain disruptive technologies, including AI. Other emerging technologies that are likely to rapidly change the way humans create, exchange and distribute values include genome editing, augmented reality, robotics, block-chain, neuro-technology and 3-D printing.

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AI has gained ascendency in the previous decade but the term was coined way back in 1956 and has several dimensions which have been described by experts in various definitions. To understand the essence, some of the abridged definitions are given below:

> "The exciting new effort to make computers think … machines with minds in the full and literal sense."[2]
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> "The art of creating machines that perform functions that require intelligence when performed by people."[3]
>
> "The study of how to make computers do things at which, at the moment, people are better."[4]
>
> "The study of mental faculties through the use of computational models."[5]
>
> "The study of computations that make it possible to perceive, reason, and act."[6]

2. Richard Bellman, *Artificial intelligence: Can Computers Think* (San Francisco: Boyd & Fraser Publishing Company, 1978).
3. Ray Kurzweil, *The Age of Intelligent Machines* (USA: MIT Press, 1990)..
4. Elaine Rich and Kevin Knight, *Artificial Intelligence* (New Delhi: Tata McGraw-Hill, 1991).
5. Eugene Charniak, *Drew McDermott, Drew V. McDermott, Introduction to Artificial Intelligence* (New York: Addison-Wesley, 1985).
6. Patrick Henry Winston, *Artificial Intelligence* (New York: Addison-Wesley Publishing Company, 1992).

"AI … is concerned with intelligent behaviour in artefacts."[7]

In a nutshell, AI is a technological pursuit towards making machines think like humans and act like humans in a rational and reasonable manner. Metaphorically, while Wright Brothers succeeded in making the first heavier than air machine fly, AI is aiming at making a machine that would fly exactly like a pigeon in a manner that neither pigeons nor humans would be able to distinguish between a real and AI enabled machine pigeon.

Even before the term AI was coined, Alan Turing (1950) had designed a Turing Test to provide a satisfactory operational definition of intelligence.[8] As per the Turing Test, a computer passes the test if a human interrogator, after posing some written questions, cannot distinguish whether the written responses come from a person or from a computer. Later, Total Turing Test was introduced, which also included a direct physical interaction so that the interrogator could assess the machine's perceptual abilities and visual ability (ability to process video signals). Recently, a technology company presented Sophia, a robot who could interact, converse and answer the verbal questions in real time almost like a human being. To pass such tests, computers or machines would require to have the following broad capabilities:

Table 1: Broad Verticals of Artificial Intelligence

Natural Language Processing	To communicate successfully in a human language, say, English or Hindi
Knowledge Representation	To store what it knows or hears
Automated Reasoning	To use the stored information to answer questions and to draw new conclusions
Machine Learning	To adapt to new circumstances and to detect and extrapolate patterns
Computer Vision	To perceive objects
Robotics	To manipulate objects and move about

7. Nils J. Nilsson, *Artificial Intelligence: A New Synthesis* (San Francisco: Morgan Kaufmann, 1998).
8. "Turing Test: Artificial Intelligence", at https://www.britannica.com/technology/Turing-test, accessed on September 23, 2020.

AI, based on capabilities, is essentially of three types, namely Weak or Narrow AI, General AI and Super AI. Weak or Narrow AI is a type of AI which is able to perform a dedicated task with intelligence. Some examples of Narrow AI are playing chess, purchasing suggestions on e-commerce site, self-driving cars, speech recognition, and image recognition. Alpha Dogfight Challenge also belongs to this very category. General AI is a type of intelligence which could perform any intellectual task with efficiency like a human. Super AI is a level of Intelligence of Systems at which machines could surpass human intelligence, and can perform any task better than humans with cognitive properties. As on date, the most common and currently available AI is Narrow AI. AI enthusiasts opine that AI world will graduate from Narrow to General and eventually to Super AI in quick succession. On the contrary, some experts believe that this transition would not be that easy and may take a very long time, if at all it fructifies.

AI IN OUR LIVES

Undeniably, AI has subtly crept into our daily lives. Be it smartphones, social media, music and media and their streaming, video games, online streaming of advertisements, navigation and travel, banking and finance, smart home devices, smart cars, drones, security and surveillance systems, all are using AI technology in one way or the other. As per some estimates, over 75 per cent of the electronic daily devices are in some way powered through AI.[9] What advertisements we see online, what music is streamed to us, auto generated emails we receive when we do online banking, Google Assistant, Alexa or Siri, hiring of Uber or Ola taxis, GPS guidance for road routes and traffic analysis, online ticket booking sites, all involve commercial applications of AI technologies. There are more than 50,000 Tesla cars on US roads today and all are interconnected. Anything learned by one car is shared across

9. "European Cooperation in Science and Technology: Session XXII", The Johns Hopkins Model United Nations Conference, February 7-10, 2019, at https://www.jhumunc.org/wp-content/uploads/2018/11/European-Cooperation-in-Science-and-Technology-2019.pdf, accessed on September 17, 2020.

all the cars. Global Digital Advertisement Industry, wherein targeted advertisements are pushed to the internet users after analysing their tastes, preferences and requirements, is expected to cross US$300 billion in 2019. In American equities, computer driven investments including AI had reached US$4.3 trillion in late 2019, exceeding the sums actively run by humans for the first time.[10] The 'Big 4' technology companies, namely, Apple, Amazon, Facebook and Google, have collective capital worth more than US$5 trillion which is way beyond India's GDP, and all these companies are majorly investing in developing and harnessing AI technologies.

Recently, cognitive and articulation skills of AI were exhibited when GPT-3, an AI language generator that produces machine learning to produce human-like text, wrote an essay to convince the readers (read, humans) that robots have a peaceful purpose and humans have nothing to fear from AI. Robot entitled the essay "Are You Scared Yet, Human?"[11] The editor confessed that it took less time to edit this machine generated op-ed, than any human op-eds.

Remotely controlled UCAVs have exhibited their might in air-to-ground strikes in a favourable uncontested air space. The most recent demonstration of a successful UCAV military operation was the neutralisation of Qasem Soleimani, an Iranian General in the Islamic Revolutionary Guard Corps, by an American UCAV near Baghdad International Airport in January 2020. Such operations are remotely controlled operations of modern times exploiting high-end Network Centric Operations with a very high degree of C4I2SR (Command, Control, Communications, Computers, Intelligence, Information, Surveillance, and Reconnaissance).

Back home, state police and other government agencies have started deploying drones. Kerala police has inducted robots for police work. Chennai is witnessing robot themed restaurants where robots serve the customers and

10. "The Rise of the Financial Machines", *The Economist*, October 3, 2019, at https://www.economist.com/leaders/2019/10/03/the-rise-of-the-financial-machines, accessed on September 11, 2020.
11. "Are You Scared Yet, Human?" *The Guardian*, September 8, 2020, at https://amp.theguardian.com/commentisfree/2020/sep/08/robot-wrote-this-article-gpt-3?CMP=share_btn_tw&__twitter_ impression=true, accessed on September 13, 2020.

also interact with them in English and Tamil. In Ahmedabad, a cardiologist performed the world's first in-human telerobotic coronary intervention on a patient located 32 km away. Complex, risk-intensive processes would be increasingly delegated to AI systems.

AI AND AIR COMBAT

Air combat operates at an entirely different level. In today's technological scenario, air combat is performed by human pilots in three dimensions, in an extremely dynamic environment wherein two fighters approach each other at speeds in excess of 1,500 miles per hour, flying at altitudes near 40,000 feet, exploiting aerospace physics, skills, art and intuition to manoeuvre a fighter aircraft and missiles against an adversary. The selection and application of air-to-air tactics requires assessing a tactical advantage or disadvantage and reacting appropriately in microseconds. The cost of mistakes could be very high. Given an average human visual reaction time of 0.15 to 0.30 seconds, an even longer time to think of optimal plans and coordination with friendly forces for critical decisions inhibit remote operation of UCAVs in air combat.

Attempts are being made to address these limitations. There is a huge window of improvement that AI can capitalise upon. While some proponents of AI are looking at increasing autonomous capabilities in terms of heralding an era of designing aircraft that can perform extremely high-g manoeuvres as well as the benefit of reducing risk to our pilots, more challenging is to enhance capabilities of real-time autonomous decision making.

In 2016, a team comprising representatives from industry, US Air Force and University of Cincinnati, Ohio had organised a simulated air combat between ALPHA, an AI agent, versus an experienced fighter pilot and instructor of USAF. AI-enabled ALPHA defeated an experienced human combat flight instructor in a combat simulation, though defined and limited in many ways. ALPHA, a research tool for manned and unmanned teaming in a simulation environment, had consistently outperformed a baseline

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computer program previously used by the Air Force Research Lab for research. In other words, it defeated other AI opponents.[12]

ALPHA was a genetic-fuzzy[13] system specifically designed for use with Unmanned Combat Aerial Vehicles (UCAVs) in simulated air-combat missions for research purposes. Researchers could make ALPHA operate in the domain of microseconds by utilising low-budget, consumer grade products. The speeds at which ALPHA can intelligently operate serve as a distinct advantage within the context of air-to-air combat vis-à-vis human pilot.

Ever since, AI has been evolving. In the earlier mentioned DARPA project titled Alpha Dogfight Challenge, after two days of old school dogfighting, i.e., going after each other using nose-aimed guns only, amongst eight contestants Heron Systems emerged a winner against a human pilot and won five rounds to zero.[14] In a well-defined game of skills, machine outperformed humans once again. More importantly, existing knowledge and conscious and unconscious biases were found to be hindering the knowledge curve. Heron System's AI enabled freewheeling learning through simulations and trial-and-error learnt better and faster as compared to Lockheed which had a fighter pilot for advising their efforts. That is why, Heron Systems, a small group working on the machine learning and AI could win hands down.

12. M. B. Reilly, "Beyond Video Games: New Artificial Intelligence Beats Tactical Experts in Combat Simulation", *UC Magazine,* June 27, 2016 published by University of Cincinnati, at https://magazine.uc.edu/editors_ picks/recent_features/alpha.html, accessed on September 10, 2020.
13. Boolean system is absolutely binary. Truth value, 1 represents absolute truth value and 0 represents absolute false value. But in the fuzzy system, there is no logic for absolute truth and absolute false value. In fuzzy logic, there are intermediate values between 0 and 1 to represent what is partially true and partially false. The term fuzzy refers to things which are not clear or are vague. In the real world we often encounter situations when we can't determine whether the state is true or false, there fuzzy logic provides a valuable flexibility for reasoning considering the inaccuracies and uncertainties of any situation.
14. Patrick Tucker, "In five rounds, an Artificially-Intelligent Agent showed that it could outshoot other AI's, and a human. So what happens next with AI in air combat?" *Defense One*, August 20, 2020, at https://www.defenseone.com/technology/2020/08/ai-just-beat-human-f-16-pilot-dogfight-again/167872/, accessed on September 8, 2020.

At the same time, it is too premature to infer that fighter pilots will become obsolete soon. Human decisions/intervention would continue to matter. Rather, future air operations would witness greater synergy between fighter pilots and autonomous AI enabled systems. Humans will increasingly outsource AI for the highly skilled precision aspects of the military operations, while retaining the tasks in which humans are still the best, i.e., high order strategic thinking. Air Combat Evolution (ACE) Programme of DARPA is focused towards enhancing Machine-Human symbiotic relationship.[15] ACE seeks to create a hierarchical framework for combat autonomy in which higher-level cognitive functions like doctrines, strategies, engagement strategies and prioritisation of targets, target-weapon matching depending upon the desired effects would likely be performed by humans, while lower-level functions like engagement tactics will be left to autonomous machines. To begin with, visual dogfight like scenarios will be made more autonomous and slowly autonomy will progress towards beyond visual range engagements.

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Emerging technologies are taking air combat in a direction wherein a single human pilot will be equipped to effectively orchestrate multiple autonomous unmanned platforms from within a manned aircraft, shifting the human role from a single platform operator to mission commander in a manner that the human pilot will be able to monitor and deliver a broader air mission while teamed unmanned systems would be engaged in individual tactics.

15. Col. Daniel Javorsek, "Air Combat Evolution (ACE)", Defense Advanced Research Projects Agency, at https://www.darpa.mil/program/air-combat-evolution, accessed on September 16, 2020.

TACTICS AND AIR COMBAT IN IAF

For about four decades, IAF's doctrines and tactics were largely influenced by the RAF. But the massive expansion of the 1960s involving acquisition of modern fighter aircraft and other operational platforms called for indigenous doctrines and tactics. Hence, IAF had established Tactics and Air Combat Squadron (TACS) in 1971, later, it was expanded to be known as Tactics and Air Combat Development Establishment (TACDE).[16] Since 1971, TACDE, has been developing combat tactics and proving its worth in peace as well as in war, be it the unprecedented victory of 1971 War, the precision bombing during Kargil War, Balakot Strike, or superior air combat tactics displayed during international air exercises in India or abroad.[17]

Management experts opine that companies with a mindset of previous decades (which harnessed IT revolution or the Third Revolution) are likely to meet their Kodak moment and perish, unless they proactively focus on emerging technologies and incessantly evolve a futuristic and interactive strategy. Redundancy of a company may lead to some socio-economic ripples but such voids would soon be filled by a more futuristic, dynamic and energetic business company since economic markets don't allow a vacuum to exist. However, national militaries, the last bastions of national defence, cannot afford to be found wanting when they are needed the most. To maintain/gain strategic competitive advantage over their adversaries, air forces need to be alive to the global emerging trends and need to work towards developing, adopting/adapting and exploiting the emerging trends in disruptive technologies, including AI.

AI RESEARCH IN INDIA

Government of India has been pursuing the requirement of enhancing indigenous research on AI, Robotics, Big Data, and Scientific Research since

16. Official website of the IAF, at https://indianairforce.nic.in/content/tactics-air-combat-development-establishment, accessed on September 12, 2020.
17. Interview of Air Marshal B Suresh (retd.), former Air Officer Commanding in-Chief Western Air Command who had three tenures in TACDE including Commandant, by Anantha Krishnan M posted at Tarmak Talking, at https://www.youtube.com/watch?v=9HAbv1o4Qp0, accessed on September 10, 2020.

long. CAIR (Centre for Artificial Intelligence and Robotics) was established under DRDO way back in October 1986. In the recent past, many initiatives have been taken to enhance focus on harnessing the potential of AI. In 2017, Ministry of Commerce and Industry had constituted a Task Force to embed AI in national economic, political and legal thought processes so that there is systemic capability to support the goal of India becoming one of the leaders of AI-rich economies. In 2018, Department of Defence Production, under the Ministry of Defence, had constituted a Task Force for 'Strategic Implementation of AI for National Security and Defence', under the Chairmanship of Shri Natarajan Chandrasekaran, the Chairperson of Tata Sons. Amongst its other recommendations, this task force had recommended establishment of a high level Defence AI Council (DAIC) with RM as the Chairman and constitution of Defence AI Project Agency (DAIPA) with Secretary (Defence Production) as the Chairman.[18] In 2018, NITI Aayog published a detailed paper titled "Discussion Paper on National Strategy for Artificial Intelligence: AI For All".

The Union Budget of 2019 also emphasised on greater focus in higher education and scientific research in the country and establishment of National Centre for Artificial Intelligence. The 2019 Budget had proposed that 10 million individuals should be trained in industry-relevant skills like artificial intelligence, robotics, big data, VR and others to address the severe skill shortage which is felt by IT companies. A Centre of Excellence (CoE) in AI has been established at NIC for responsive governance and to work towards improving government service delivery to citizens.[19]

National Education Policy (NEP) 2020 has recommended establishment of a National Research Foundation to fund outstanding peer-reviewed research and to actively seed research in universities and colleges while enhancing focus on emerging fields of AI and data sciences. Expenditure

18. Commander Subhasish Sarangi, "National Initiatives on Artificial Intelligence in Defence", Apr-Jun 2019, published on The United Services Institution of India, at https://usiofindia.org/publication/cs3-strategic-perspectives/national-initiatives-on-artificial-intelligence-in-defence/, accessed on September 23, 2020.
19. Official website of National Informatics Centre, at https://www.nic.in/emerging_technology/centre-of-excellence-artificial-intelligence/, accessed on September 23, 2020.

on education has also been recommended to be increased to 6 per cent of GDP. Currently, Govt of India spends about 3 per cent of its GDP on education.

AI research and development ecosystem largely requires three core components. First, availability of educated talented pool. Second, world-class educational institutions for academic research. Third, capable IT industry to create value products by harnessing the ecosystem and the national potential. Prima facie, India has the ecosystem and the necessary building blocks in place. India produced a whopping 2.6 million STEM (Science, Technology, Engineering and Mathematics) graduates in 2016, second only to China and more than 4 times the graduates produced by the USA.[20] IITs and IISc are well accomplished academic institutions of higher education and learning. TCS, Infosys and Wipro are some of the leading Indian IT companies with operations all over the world. Despite these advantages, India appears to be considerably lagging in producing world-class research and innovation in most technology fields, including in AI. Overwhelming majority of this talent pool, as per the NITI Aayog report, is focused on routine IT development and not so much on research and innovation. Exacerbating the problem further, a majority of the small population focused on research almost always prefers to pursue advance degrees (Masters or PhD degrees) to subsequently apply their expertise abroad.[21]

The contribution of the leading Indian IT services companies like TCS, Wipro and Infosys to research is found to be very limited. Given that these IT giants have been working closely with businesses globally and anticipating the trends in emerging technologies, it wouldn't be unreasonable to expect a sizeable volume of research work coming out of these companies. Yet, looking at all the research publications from 2001 to 2016, only 14 per cent of all publications have come from industry, with universities contributing 86 per cent of all publications. Even this limited research publication by

20. Niall McCarthy, "The Countries with the Most STEM Graduates", *Industry Week*, February 6, 2017, at https://www.industryweek.com/talent/article/21998889/the-countries-with-the-most-stem-graduates#:~:text=The%20World%20Economic%20Forum%20reported,recent%20STEM%20graduates%20in%202016, accessed on September 12, 2020.
21. NITI Aayog, "Discussion Paper on National Strategy for Artificial Intelligence: #AI FOR ALL" (New Delhi: Government. of India, 2018), p. 50.

industry is dominated by Indian subsidiaries of international companies (~70 per cent), with only one Indian company featuring in top-10 (TCS). Indian IT industry with over US$ 160 billion annual revenue, is yet to build worthwhile pioneering AI/Machine Learning capabilities commensurate with its potential. In 2017, Indian start-ups could raise just about US$ 87 million, as against over US$ 28 billion raised by the Chinese start-ups.[22]

For developing cutting-edge disruptive technologies, there is no alternative to intellectual and resource investments in R&D. Unfortunately, as compared to international initiatives, be it in government or private sector, India's track record in investments in R&D is not very encouraging. India's investment in research and innovation investment is just about 0.69 per cent of GDP. On the other hand, Israel invests about 4.3 per cent, South Korea about 4.2 per cent and USA about 2.8 per cent of their respective GDPs.[23] In India, even this minuscule investment is not being effectively utilised for undertaking quality research in Higher Education. As per NEP 2020, despite various initiatives and improvements in the status of the academic profession, faculty motivation in terms of teaching, research, and service in higher education institutes (HEIs) could be improved.[24]

Data on engineering colleges in India is hugely perplexing. On the one hand, AICTE (All India Council of Technical Education) has started discouraging opening of new engineering colleges owing to existing college seats remaining vacant (out of 27 lakh net intake capacity, only 13 lakh students took admissions in 2019-20, leading to more than 50 per cent vacant seats).[25] On the other hand, admission in IITs is considered one of the most challenging admission processes globally, wherein for about 23,000 seats in the IITs more than 8 lakh students competed and applied for JEE (Joint Entrance Examination) in 2020.

22. Ibid., pp. 71-72.
23. Ministry of Human Resource Development, National Education Policy 2020 (New Delhi, 2020), Part II, p. 45.
24. Ibid., p. 40.
25. "AICTE not to Set up New Engineering Colleges for 2 Years", *The Week*, February 14, 2020, at https://www.theweek.in/news/sci-tech/2020/02/14/AICTE-No-new-engineering-college-for-2yrs.html#:~:text= The% 20All% 20India%20Council%20for,too%20many%20institutes%20offering%20B, accessed on September 16, 2020.

There is a need to change the focus from churning out huge quantities of low grade engineering graduates, that too in traditional streams, to enhancing quality education in emerging fields including AI, deep learning and machine learning, and create world-class academic institutions to produce highly competent researchers.

As per the Global AI Talent Report 2018, out of a total of 22,000 PhD educated researchers worldwide, India has only 386. The report also looks at leading AI conferences globally for presenters who could be considered influential experts in their respective field of AI. On this metric, India was ranked 13th globally, with just 44 top-notch presenters. It is estimated that serious research work in India is limited to less than 50 researchers, concentrated mostly at institutes like IITs, IIITs and IISc. While India may be producing research pieces in huge numbers, their utility has been considered rather limited. Looking at the research coming out of academic institutes, the numbers are heavily skewed in favour of top-15 institutes which have contributed more than 42 per cent of all research publications from 2001 to 2016. IISc dominates the research publications, with 7.5 per cent of all publications coming from this institute. For a country that has more than 750 universities and close to 40,000 colleges, this concentration of publications is a worrying sign.[26] Undoubtedly, there is a need to change the focus from churning out huge quantities of low grade engineering graduates, that too in traditional streams, to enhancing quality education in emerging fields including AI, deep learning and machine learning, and create world-class academic institutions to produce highly competent researchers.

Data is the bedrock of AI systems and reliability of AI systems depends primarily on quality and quantity of the data. One of the important challenges in India is to collect, validate, standardise, correlate, archive and distribute AI related data, making it accessible to organisations, peoples and systems without compromising privacy and ethics.[27]

26. NITI Aayog, n. 21, p. 51.
27. Sarangi, n. 18.

LEGAL/ETHICAL CHALLENGES ASSOCIATED WITH AI

Will advent of AI reduce the legal conflicts or will it enhance the burden on legal structure? Is our legal framework and other government machinery adequately equipped to handle emerging legal challenges as the ground-breaking technologies mature and scope of their commercial usage expands? Probably not. Certain examples of complexities associated with AI and machine learning are enumerated in subsequent paragraphs.

Most of the current AI systems and their algorithms work in a manner that only input data and results are known to the developers. This is commonly known as "Black Box Phenomenon". What is happening in-between is not known since developers are entirely focusing on incremental improvement in the system.

Suppose there is an accident of an autonomous car. What mechanism will follow to judge who is the liable/guilty party? Will it be the programmer in the office who made the source code? Will it be the owner of the car or the passenger(s) at the time of the accident? Will it be the manufacturer in the lab with the testing protocols? As per some media news, in the self-driving cars, Mercedes-Benz has chosen to prioritise passengers' safety over pedestrians'. Will it be legally and ethically acceptable to give such priority or would it be unethical and against the Fundamental Right of Equality of pedestrians? What will be the impact of driverless cars on the insurance premium being charged for the cars with human drivers since driverless cars would be expected to be much safer and *'human error proof'*.

Most of the current AI systems and their algorithms work in a manner that only input data and results are known to the developers. This is commonly known as "Black Box Phenomenon". What is happening in-between is not known since developers are entirely focusing on incremental improvement in the system. But, understanding of the decision making process would be significant from the legal and ethical perspectives.

What should the algorithms dictate in a situation of an inevitable accident? How would an autonomous car choose between the options of saving the passenger or the pedestrian or the property? Trolley Problem, introduced by Philippa Foot in 1967, is a well-known instrument to highlight the moral question of utilitarianism. Whether it would be socially and morally acceptable to allow someone to die in an accident for a greater good of saving others? Killing someone to save more lives or letting someone die in order to save more lives have entirely different neurological and ethical connotations. What statistical logics should be defined to programme driverless vehicles needs further debate. Germany has covered some ground in this regard by incorporating ethical rules for the driverless vehicles mandating that human life would always be given priority over property or animal life. China, Japan and Korea are following the lead.

Similarly, if a telerobotic invasive surgery on a patient in India is performed by a surgeon physically located overseas—and having different law of the land—doesn't unfold in the intended manner owing to failure of electricity, then what legal action can be initiated and against whom? How should the responsibility be fixed? Similarly, there could be an unintended damage by an AI operated UCAV operating in/transiting through a foreign airspace.

Who will be responsible if an AI enabled machine commits a crime? Switzerland is witness to a case wherein Random Darknet Shopper, a robot that can be purchased online, had bought a contraband item—ecstasy pills—online using the deep web. Similarly, The CyberLover, a chatbot malware, could engage people in conversations with the objective of inducing them to reveal information about their identities or to lead them to visit a website that will deliver malicious content to their computers.[28]

AI systems largely apply learning techniques from statistics to find patterns in large sets of data and make predictions based on these patterns which are used in a variety of applications. Many believe that data science is not neutral since predictive models and algorithms bear the biases and

28. S. Withers, "Flirty Bot Passes for Human", at https://www.itwire.com/your-it-news/home-it/15748-flirty-bot-passes-for-human, accessed on June 14, 2019.

prejudices of the people who have created and are using them. Hence AI is inherently biased. Such sociologists opine that marginalised sections of society should not expect any justice from data science.

Will the Robots be humanised? As the distance between AI and Homo Sapiens is reducing, AI may get closer to actual consciousness. Will attributing them a legal entity be in order? Though parallels cannot be drawn, there are enough examples of according legal entity to various non-living objects. New Zealand had passed a law recognising Whanganui River as a legal entity in 2017. Back home, in 2000, the Supreme Court of India recognised the main sacred text of the Sikhs, the Guru Granth Sahib, as a legal entity.[29] On the other hand, in 2017 the Supreme Court had overruled an order by the High Court in Uttarakhand state, which said that the Ganges and Yamuna rivers had the same legal status as human beings and directed that these two rivers cannot be viewed as living entities. All registered business companies are considered as legal entities in order to carry out justice in a speedy and effective manner. Moreover, legal entities are only deemed to be criminally liable if it is determined that an individual was performing illegal actions on behalf of the legal entity. However, the actions of artificial intelligence-based systems will not necessarily be traced back to the actions of an individual. Another important question is, can the robots act as a witness in a legal case?[30]

It is a known fact that government, law making and state bureaucracy generally find it difficult to match up with the speed with which the business companies evolve. In India, law of the land has its own excruciatingly slow speed of delivery. India has a pendency of about 3.3 crore cases and average pendency of a case reaching up to Supreme Court is about 23 years.

For certain crimes probably the entire law process can be automated with the help of AI. Say, detecting and challan process for overspeeding of cars in a city. The core objective of such technology is efficiency and reduction in manual labour. But, some specialists opine that humans may

29. T. P. Rao, "Guru Granth Sahib, A Juristic Person: SC", *The Hindu,* Hyderabad, April 3, 2000.
30. G. S. Bajpai and M. Irshad, "Artificial Intelligence, the Law and the Future", *The Hindu,* Hyderabad, June 11, 2019.

be inefficient yet they are more capable of connecting ethical issues and contextualising the decision making process. Human involvement also helps in preserving the basic tenets of law enforcement—leniency and discretion. Therefore, it is opined that simple jobs like document coding may be automated but situations involving conflicting rights, unique fact patterns and open-ended laws would be difficult to automate. AI related legal cases will certainly enhance the challenges for lawyers as well as for judges and judicial officers. The NITI Aayog report has also touched upon the questions of ethics, privacy and security and has suggested that a consortium of Ethics Councils may be constituted at each Centre of Research Excellence (CORE).[31]

Legally, to begin with, there is a need to articulate legal definition of AI. AI needs to be accountable, fair and transparent. Sustainability of an innovation is as important as its social acceptability. Ethics and law are linked to each other in an inextricable manner. Many legal decisions have their basis in the ethical dimensions. Working on liability scheme and Intellectual Property Rights (IPR) issues is also important. Regulating usage and security of data is a critical aspect since privacy is a fundamental right.

THE WAY AHEAD

The human mind is extremely powerful. While some believe that it will always have unbeatable performance in certain areas, others paint a futuristic environment wherein AI will overtake human intelligence in a comprehensive manner, be it natural intelligence or emotions. In any case, performance of AI and its applications are going to increase across the spectrum in a big way, including the field of air combat.

The unprecedented speed of the Fourth Industrial Revolution would not give the militaries, governments and the supranational organisations much time to act. Looking into the future for predicting technology advancements and associated dimensions—including legal/ethical issues—would be a

31. NITI Aayog, n 21.

complex process. AI would also affect the way we look at state-corporate-citizen relationship. Hence, governance would confront major challenges and it cannot afford to fail. Sweden, way back in 1973, in a ground-breaking move for future planning, had appointed a Minister of State to review the role of future studies. Subsequently, in 2014 "Ministry of the Future" was created.[32] Sweden, along with South Korea, are amongst the few countries to have such a body.

India could take a leaf from their book, since today, for the economic, intellectual, societal, environmental, and technological health and progress of the nation, criticality of quality research and 'out of the box' thinking is required more than ever before. All the stakeholders need to urgently start working on a multidisciplinary approach towards understanding the nuances of the emerging field of AI, evolving dependable and implementable ecosystem in a time-bound and swift manner so that quality research is pursued. Institutionalisation of robust laws is indicated to effectively and logically deal with various contingencies which AI will throw up. A delayed response would increase the competitive gap to an extent that India might lag behind to a point of no return.

32. "Sweden: A 'Ministry of the Future' to Think about Tomorrow's Public Policy", *Responsive Public Management*, no. 82, April 2016, at https://www.economie.gouv.fr/files/files/directions_services/igpde-editions-publications/revuesGestionPublique/IGPDE_Reactive_Suede_avril_2016_En.pdf, accessed on September 17, 2020.