Artificial Intelligence and the Changing Nature of Warfare

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Abstract

Software is eating the world and Artificial Intelligence is eating software, but weaponry is breathing Artificial Intelligence.[1] *Weaponry and warfare are inextricably connected. Important features of weaponry have remained dependent on technology. From ancient times to current, every technological breakthrough has made weaponry more advanced by enhancing their capacities. Some of the distinct features which Artificial Intelligence has added to the field of weaponry now include perception, cognition and action (will). Currently, autonomous weaponry is between semi and fully autonomous stages of development. If the change persists, human control over weaponry will gradually diminish. If technological singularity is materialised, it will be done at the expense of invincible weaponry and extinction of Homo sapiens.*[2]

Keywords: Artificial Intelligence, Autonomous Weaponry, Homo sapiens, Warfare

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[1] Simonite, Tom, 'Nvidia CEO: Software Is Eating the World, but AI Is Going to Eat Software', *MIT Technology Review*, May 12, 2017, https://www.technologyreview.com/s/607831/nvidia-ceo-software-is-eating-the-world-but-ai-is-going-to-eat-software/.

[2] Singularity is a hypothetical future creation of super intelligent machines. Superintelligence is defined as a technologically created cognitive capacity far beyond that possible for humans.

Introduction

Nature loves intelligence and Homo sapiens are the acme of intelligence. The romance between nature and intelligence has allowed humans to become the kingpin of intelligence. Only because of higher intelligence, Homo sapiens are capable of defending themselves against interspecies and intraspecies threats despite of some weak characteristics compared to other animals. Their physical strength is dwarfed by stronger species, they lack in natural force protection as they have no spikes nor armature, their mobility lacks far behind that of a lion or a dog and their bodies do not possess defensive mechanisms yet they are superior to all other species. However, the question remains as to how the Homo sapiens overpowered those better protected, stronger, bigger, larger, faster and deadlier species?

The answer lies in a simple fact. It became possible not through brute physical force but through unique sublimity of intelligence.[3] In genuine sense, it was intelligence that propelled Homo sapiens from an animal of no significance to a species undisputedly governing the top of the food chain. According to a military historian from Israel, Yuval Noah, Homo sapiens achieved this unique position through their cognitive skills.[4] At the time of the Cognitive Revolution, the earth was home to about 200 genera of large terrestrial mammals, however, by the time of the Agricultural Revolution, only about a hundred of them remained.[5] Homo sapiens forced extinction on more than half of the gigantic animals due to intelligence superiority over them long before they invented the wheel, writing and iron tools. Homo sapiens proved equally and ruthlessly successful against other advanced species such as great apes, Homo soloensis, Homo denisova, Homo florensis and the more widely known Homo neanderthalensis, which became extinct.[6]

History offers profound evidence that extinction of all those species was not due to physical inferiority or due to small brains but because they were

[3] Norving Peter and Russal Stuart, *Artificial Intelligence: A Modern Approach*, (New Jersey: Pearson Education, Inc, 2010).

[4] Yuval Noah Harari is an Israeli historian and a tenured professor in the Department of History at the Hebrew University of Jerusalem.

[5] The thinking ability that sparked in human brains about 70,000 years ago.

[6] Sister species of Homo sapiens.

deprived of cognitive skills. On the other hand, these cognitive skills enabled Homo sapiens to manufacture lethal tools and weapons for their defence and protection. Initially, the nature of defence was interspecies which subsequently evolved into an intraspecies nature of defence mechanism between and among different clans of Homo sapiens. Since the Mesolithic period (8,000 BC) to the late Industrial Revolution, the lethality of weaponry evolved from stone weapons to nuclear weapons. At the same time, rather than just creating lethal weaponry, Homo sapiens also leveraged their intelligence in various non-physical ways to become more sophisticated in how they prepare for war which included but were not restricted to communications, command, control, logistics and propaganda. As of present times, the human race stands at a critical juncture in evolution where Homo sapiens are uncovering and developing new forms of intelligence that could surpass their own cognitive abilities. With the recent eruption of various forms of Artificial Intelligence (AI), the traditional map of weaponry and warfare with varying degrees of domains and ranges is being altered, uprooted and conquered by AI features.

What is AI?

There is a lack of consensus on the definition of AI but experts have drafted a common definition. Simply, it is, 'a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think and perceive abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings—catching on, making sense of things, or figuring out what to do'.[7]

Brief History of AI

In order to understand AI weaponry, it is essential to examine the evolution in its definitional course. In the last 70 years the development of AI has undergone many stages of optimism and despair both at the same time. Its initial foot prints can be found in the 1940s, but the development of AI got a major breakthrough at the Dartmouth Conference in 1956.

[7] Linda S. Gottfredson, *Mainstream Science on Intelligence: An Editorial with 52 Signatories, History, and Bibliography*, (1994), http://www.intelligence.martinsewell.com/Gottfredson1997.pdf.

The evolution of AI can be divided into 10 stages though different experts described various stages of AI. According to Stuart Russell and Peter Norvig these are; the gestation of AI (1943-1955), the birth of AI (1956), early enthusiasm, great expectations (1952-1969), a dose of reality (1966-1973), knowledge based systems: the key to power? (1969-1979), AI becomes an industry (1980-present), the return of neural networks (1986-present), AI adopts the scientific method (1987-present), the emergence of intelligent agents (1995-present), and the availability of very large data sets (2001-present).[8] [9]

The first stage is based on a network of artificial neurons. Each artificial neuron in the web of other artificial neurons turns off and on according to the stimulation process and automation and can be updated according to Hebbian Learning.[10] A lot of work on this front was done during the early 1940s, but it was Alan Turing who became most influential in this regard.[11] His article on Computing Machinery and Intelligence became the basis of the Turing test, machine learning, genetic algorithm and reinforcement learning.

The second stage proved to be the cornerstone for AI development. John McCarthy was its architect.[12] McCarthy possessed intelligence curiosity and an unparalleled quest for the development off AI in an organized manner. For this purpose, he left Princeton and Stanford and went to Dartmouth College. It was he who brought researchers like Minsky, Claude Shannon, and Nathaniel Rochester together. They organised a two month workshop at Dartmouth in 1956. The workshop comprised of ten researchers including Trenchard More from Princeton, Arthur Samuel from International Business Machines (IBM), and Ray Solomonoff and Oliver Selfridge from Massachusetts Institute of Technology (MIT).[13] The core themes of the conference were automata theory, neural nets, and the study of intelligence. Herbert Simon and Allen Newell came up with

[8] Stuart Jonathan Russell is a computer scientist known for his contributions to AI.

[9] Peter Norvig is an American computer scientist. He is a director of research at Google Inc.

[10] Hebbian learning is one of the oldest learning algorithms and is based in large part on the dynamics of biological systems

[11] Alan Mathison Turing OBE FRS was an English mathematician, computer scientist, logician, cryptanalyst, philosopher, and theoretical biologist.

[12] John McCarthy was an American computer scientist and cognitive scientist.

[13] The research project on AI is considered a critical event in evolution of AI which took place in the summer of 1956.

the reasoning program that stole the show; the Logic Theorist (LT), about which Simon claimed, 'We have invented a computer program capable of thinking non-numerically, and thereby solved the venerable mind—body problem'.[14] Although it was rejected by the experts, it paved the way for future research of non numeric computation. Certainly, the Dartmouth workshop could not bring about a major breakthrough but it did introduce all the major figures to each other. For the next two decades, the field was dominated by these people, their students and colleagues at MIT, Carnegie Mellon University (CMU), Stanford, and IBM.

The third stage constitutes four elements; the list of X's, footprints of General Problem Solver (GPS), the micro/block worlds and Minsky-McCarthy contributions. The early computers were arithmetic task oriented but gradually started to perform other tasks and it was fascinating whenever a computer did anything remotely clever. Meanwhile the intellectual elite propagated, 'A machine can never do X'.[15] It was natural for researchers to respond and demonstrate one X after another. This period was referred by McCarthy as 'Look, Ma, No hands!'[16] The GPS of Newell and Simon was designed to imitate the human problem solving approach, which after going through some puzzle classes embodied human approach in it. This was incorporated in GPS, thus GPS emerged first to embody human thinking approach. Another important development was the introduction of micro world or blocks world. It consisted of a set of blocks placed on the table and the task was to rearrange the blocks in a certain way by using a robot hand to pick the blocks. This program provided the base to vision project of Huffman and the perceptron theorem. In the second half of the 1950s, John McCarthy and Marvin Minsky moved to MIT where they worked for a long time and supervised many students who choose limited problems which required intelligence to solve. Notable limited domains were James Slagle's SAINT program which was able to solve closed form calculus integration problems, Tom Evans's ANALOGY program which solved geometric analogy problems that appear in Intelligence Quotient (IQ) tests and Daniel Bobrow's STUDENT program which solved algebra story problems. These limited

[14] Herbert A. Simon, *Models of My Life* (United State: MIT Press,1996).

[15] A. M. Turing, "Computing Machinery and Intelligence," *Mind* 49, (1950):433-460.

[16] Robert A. Wilson and Frank C. Keil ed., *The MIT Encyclopaedia of Cognitive Sciences,* (Massachusetts: MIT Press, 1999).

domains are known as micro worlds.

AI researchers began predicting their successes with different interpretations. Hence, terms like visible future emerged. It was Simon's prediction that within 10 years, the computer would be the champion of chess and machines would start to perform mathematic functions, though the time stretched to 40 years. However, all developments had to face failure. In this stage, AI's development faced three kinds of difficulties. The first difficulty was that early AI programs knew nothing about subject matters but were rather aware of merely simple syntactic manipulations. For instance, machine translation could not succeed due to this reason when Americans wanted to get the exact translation of Russian conversations at the time of the Sputnik launch. Absence of background knowledge was the primary reason of failure.

This failure resulted in introduction of knowledge based systems. Up to this stage, the nature of problem solving was general purpose (weak methods). The alternative to this approach was more powerful and domain specific knowledge in order to handle complex tasks. For this purpose, knowledge based system like DENDRAL (detecting molecular structure from the information provided by a mass spectrometer) and MYCIN (calculating certainty of uncertainty in medical diagnosis) were introduced.

This led to the development of a more specific expert based system. Digital Equipment Corporations (DEC) created more than 100 expert based systems for commercial purposes because it saved Dollar 40 million per year. Within limited time, nearly every major US corporation had its own AI group and was either using or investigating expert systems. In 1981, Japanese introduced the fifth generation. It was a 10 year project to develop an intelligent computer. In response to this, the US formed the Microelectronics and Computer Technology Corporation (MCC). Both had major elements of AI systems. Overall, at this stage, hundreds of companies were building expert systems; vision systems and robots based on AI. However, most companies stepped backed because of reasons of failing to develop what they promised, and this came to be known as AI winter.[17] Due to AI winter, in the next two stages, scientific methods were applied on neural networks or perceptron and agents of AI but could not bring

[17] AI (Artificial Intelligence) winter is the time period in which funding for projects aimed at developing human-like intelligence in machines was minimal.

about any meaningful breakthroughs.

Throughout the history of AI and computers, the major focus was on algorithm but in recent years data study has gained more importance. Yarowsky, Hays and Efros consider that large data studies are more important than algorithm for they induce cognition and intelligence into a machine's behaviour.[18] [19] For this purpose, they conducted an experiment in which a hole in a photograph is to be filled correctly. For instance, one uses photo editing software to mask out an ex-friend from a group photo but now needs to fill in the masked area with something that matches the background. Hays and Efros defined an algorithm that searches through a collection of photos to find something that will match. They found the performance of their algorithm to be poor when they used a collection of only 10,000 photos but crossed a threshold into excellent performance when they grew the collection to 2,000,000 photos.

These stages of evolution of AI suggest that cognition and intelligence in machines is no more a problem but the quality and extent of cognition is uncertain. The possibility and probability of its occurrence however, is subject to time.

Describing the Relationship between AI and Warfare

Throughout history, weaponry and technology have remained inseparable parts of warfare. In different times, whenever a technological breakthrough occurred it took weaponry a notch above, i.e. into another phase. In ancient times, traditional weapons like sword, bows and arrows were considered to be the most advanced weapons in the field of warfare. In pre medieval times, the invention of gunpowder in China revolutionised the weaponry and changed the rules of the game in total. In modern times, the invention of nuclear weapons has made mass annihilation possible. In post modern times, AI is set to bring cognition in weaponry. Once weaponry develops its cognition, the age of controlled weaponry by Homo sapiens will be a fairy tale of the past.

It is totally different from semi-autonomous weaponry which first selects its target and then completes the designated action with the aid of Human

[18] David Yarowsky is a Professor. Department of Computer Science at Johns Hopkins University.

[19] Efros is a Russian-American computer scientist and Associate Professor at University of California, Berkeley.

Intelligence (HI). As HI is the mother of AI, therefore we need to understand the fundamental concept of HI in order to establish the role and consequences of AI itself. The sequence of HI is trifold and involves perception, cognition and action. Perception involves how humans perceive something, cognition means brainstorming of what and how to do, and action is the doing of tasks based on the former steps. AI works on a similar pattern in which computer senses and perceives the world on the basis of database.

Three elements constitute the development of the cognition process of weaponry: thinking, detection and action. The behaviour pattern of machines or weaponry is dependent on database and computational skills. According to M. L. Cummings, four computational skills i.e. skill based, rule based, knowledge based, and expert based form machine behaviour.[20] In simple words, thinking ability of a machine is dependent on database, and detection capability of machines is directly proportional to these four behaviours, while action is the ultimate product. This process is different from machine learning or deep learning with unit distinction which is absolute or independent cognition. The ability of machine determines whether it is able to update and upgrade databases without human aid. If machines acquire this particular cognitive feature it could presage the end of human era as Claude Shannon said 'I visualize a time when we will be to robots what dogs are to humans'.[21]

Elements of Warfare

Warfare revolves around four major elements: weaponry, fields of weaponry, military doctrines, and battle. All elements of warfare have further subdivisions. The first element weaponry is composed of guns and bullets, tanks and jets, missiles and drones, submarines and aircrafts, as well as nuclear and hydrogen weapons. The second element i.e. fields of weaponry includes land and airborne weapons, space, logistics and propaganda. The third element includes military doctrines Anti-Access (A2)/ Area-Denial (AD), Command, Control,

[20] M. L. Cummings, Heather M. Roff, Kenneth Cukier *et al*., Artificial Intelligence and International Affairs: Disruption Anticipated, *Chatham House Royal Institute of International Affairs,* (2018): 7-18, https://www.chathamhouse.org/sites/default/files/publications/research/2018-06-14-artificial-intelligence-international-affairs-cummings-roff-cukier-parakilas-bryce.pdf.

[21] Rise of the Machines: How Computers Could Control Our Lives, *The* Conversation, (March 14, 2012), https://theconversation.com/rise-of-the-machines-how-computers-could-control-our-lives-5838

Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR), Air Sea Battle (ASB), and other strategic doctrines inclusive of first strike, second strike capabilities, massive retaliation rationales and Mutually Assured Destruction (MAD). The last one includes different types of battles and wars.

An insight into the evolution of weaponry or Revolution in Military Affairs (RMA) reveals that one common aspect has occurred on every stage eventually taking previous weaponised technology into another advanced stage. This common aspect was nothing extravagant but a new technological breakthrough. For instance, in the Stone Age, weapons like dagger and hammer chiselled from stones were used for hunting purposes. The invention of catapult was considered as a great advancement. The invention of sword, arrow and bow revolutionised warfare and remained indispensable warfare tools for centuries. In pre medieval times, the invention of gunpowder in China eclipsed all previous technological breakthroughs in weaponry. In modern times, with the invention of the engine and aeroplane, the domain of warfare has further expanded from one field to multi-field (i.e. from land warfare to naval and air warfare) simultaneously.

With every technological breakthrough, warfare embraced modernisation, quantitatively in general and qualitatively in particular. Weapons transformed from traditional bows and arrows to guns and bullets, from simple guns to machine guns, from tanks to missiles and from simple to nuclear bombs. Air warfare stretched to space warfare, naval warfare saw similar transition from simple ships to submarines, from simple submarines to nuclear submarines and from frigates to aircraft carriers. The journey of weaponry went on, transforming warfare from inside out to outside in.

The superiority in warfare is determined by two major aspects; qualitative and quantitative. In traditional warfare, the quantitative aspect has remained dominant; however, its influence declined with every new technological breakthrough given an overshadowing qualitative aspect. There are three types of weaponry in the realm of AI warfare: automated, semi-autonomous, and fully autonomous. An autonomous weapon system is the one which once activated, can select and engage targets without further intervention by a human operator. This includes fully autonomous weaponry that is capable of performing tasks without human control after initial activation. In semi-autonomous weapon

systems however, tasks are subject to human control even after initial activation.

Scholars like Peter Asaro and Mark Gubrud believe that a weapon system which needs no confirmation from its supervisor when it comes to releasing its lethality falls under the category of an autonomous system. According to Gubrud, 'A weapon system operating partially or wholly without human intervention is considered autonomous'.[22] [23] [24] He argues that a weapon system does not need to be able to make decisions completely by itself in order to be called autonomous rather it would perform at least one of the operations from preparation to completion. Such a weapon system can detect and counter incoming attacks of missiles, rockets and surface vessels autonomously as per the human set criterion. The Israeli Trophy and the Russian Arena are recent instances of tank defence autonomous weapon system. In similitude, Iron Dome stands as a worth mentioning instance in the case of missile autonomous system.

How AI will change the nature of Warfare

AI is not only massively altering the course of reach, speed and lethality in terms of weaponry, but is also about to bring features of autonomy that could take elements of rudimentary intelligence to ubiquitous levels. This transformational shift from automated centric mechanisms to a rather more autonomous use of weaponry involves at least three major elements as mentioned earlier, namely perception, cognition and action. Perception is the ability of perceiving something based on discriminating undertones. In warfare, generally it is considered as a response (not action) of any stimulus and traditionally connotes threat perception. Cognition is the most essential and the prime quality of autonomous weaponry that works on the basis of perception. Lastly, action is the completion of any task stretching from both perception and cognition. The domain of perception in the AI field is determined by its data, knowledge or information and these consequentially become the basis of autonomous weaponry.

[22] Dr. Peter Asaro is a philosopher of science, technology and media. His work examines artificial intelligence and robotics as a form of digital media.

[23] Mark Gubrud, "Stopping Killer Robots," *Bulletin of the Atomic Scientists* 70, no.1 (2014): 32-42.

[24] P. W. Singer, *Wired for War: The Robotics Revolution and Conflict in the Twenty-First Century* (New York: The Penguin Press, 2009).

Considering HI at par with AI, it is fairly easy to deduce that rationales of perception and cognition in AI are far behind in terms of quality, domain, range and will, but far ahead in terms of speed. In a more genuine sense, the elements of perception and cognition are in computational form made up of algorithmic patterns. Thus, these are also embedded in machine behaviour. Therefore, fully autonomous machine behaviours cannot be generated in the absence of fully autonomous perception and cognition. Resultantly, intelligence of weaponry can either be automated or can be semi-autonomous but with an added virtue of exponential speed.

Currently most of the military systems are not fully autonomous. They are either automated or teleoperated.[25] All Unmanned Air Vehicles (UAVs) are autonomous to the extent of navigation (knowledge based, expert based, deep learning and data analytics). Autonomous weaponry is under research and development stage in the US, China and Europe. Fully autonomous weaponry on the other hand is currently confronting two major barriers rooted primarily in the huge economic costs needed for their development and successful testing and secondarily in the ethical concerns. American manufactured F-22 is considered the stealthiest and most lethal jet in the world which has an hourly economic cost of Dollars 68,346.[26] Due to a huge economic cost, its production came to a halt for some time and now is under redesigning with the central feature of AI. The US and the People's Republic of China (PRC) are modernizing their weaponry and entire military systems with a keen emphasis on trying to incorporate features of the AI to develop fully autonomous weaponry. For instance, the PRC has modernised all fields of military in order to deter the US, specifically in the Pacific region. However, it is still facing both qualitative and quantitative threats with more than 60 per cent of American naval forces stationed in the Pacific Ocean vicinity. In recent past, the PRC tried to develop new military doctrines like Anti-Access (A2)/ Area-Denial (AD) coupled with Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) for its defence but the US had its parallel of Air Sea Battle (ASB) and an equivalent of its own C4ISR. So both share more or less the

[25] Stephan De Spiegeleire Matthijs Maas and Tim Sweijs, "Artificial Intelligence and The Future of Defense," *The Hague Centre for Strategic Studies*, (2017), https://hcss.nl/sites/default/files/files/reports/Artificial%20Intelligence%20and%20the%20Future%20of%20Defense.pdf.

[26] Ibid.

same qualitative features and both need a leap in this regard.

This leap is solitarily possible with AI. Struggle for AI supremacy between America, China and Russia has begun. For once, AI has become the brain of machines even to the extent of being semi-autonomous. The era of AI weapon system has the potential to engulf the entire field of warfare including land, sea, air, informational, cyber and robotics. All fields (land, naval, airborne and space) of warfare including stealth capabilities, nuclear doctrines, strategic limitations and leverages, submarines and aircraft carriers, guns and bullets, and jets and tanks will transcend into a lethal age of killer robots, cyborgs, hypersonic, drone swarms, cloud computing and machine cognition. AI is not only changing some notable features but also the nature, form, domains and ranges, hence the entire trajectory of modern weaponry. In this view, the future of weaponry vis a vis constantly transforming nature of intelligence raises some serious questions such as will AI be the replica of HI or not? The intelligence of autonomous weaponry perhaps will be the replica of HI in near future but will be deprived of autonomous cognition. That is to say that the speed of computation and algorithm of perception, cognition and action of weaponry will be much higher and faster in quantitative (speed of computation/algorithm) terms, but not in qualitative (will and control over cognition) terms. On the basis of these two distinctions, intelligence of autonomous weaponry will be light years ahead of HI in every field and form.

Future Scenarios

Given the complexities of the subject with reference to AI and weaponry, the future of warfare projects the possibility of following the course of autonomous weaponry. Though the extent of this autonomous weaponry cannot be ascertained at present, what is obvious is that it will change warfare in each and every dimension. Even the nature of weaponry will remain only at a semi-autonomous stage. It has been established that all intelligence factors are now being incorporated in robots and machines and some factors like facial recognition, machine translation, early warning systems and various systems of perception are providing new breakthroughs in the realm of the desired machine's behaviour. For instance, UAV, Unmanned Ground Vehicle (UGV), Unmanned Underground Vehicle (UUV) and Observe Orient Decide

and Act (OODA) having advanced features of AI have become top trends in AI weaponry. Even normal robots are using stereo vision to see the world around them. Cameras give them depth perception and image recognition gives them the ability to locate and classify objects. In addition, most advanced robots can analyse and adapt to unfamiliar environments.[27] As discussed above, that changing nature of weaponry has trifold dimensions or scenarios inclusive of automated weaponry, semi-autonomous weaponry and fully autonomous weaponry. AI is part of all of the stated.

Research and development is in process to achieve fully autonomous weaponry but absolutely autonomous weaponry is and will not be possible because AI cannot be modelled on HI due to compositional, structural and functional restraints. However, the fact remains that speed, lethality, reach, transcendence and possession of this kind of weaponry has the potential to be ubiquitous. That is to say that in addition to states, organisations, corporations, individuals and even terrorists and insurgent groups will be in a position to buy or manufacture such weaponry easily if not regulated properly. Undoubtedly, states will have greater leverage on other entities, but the damage would be exponentially worse. For instance, Ayoub Kara, an Israeli Druze politician asserted that Israel is developing military robots and drones as small as flies that will possess nuclear weapons. Most of the experts also endorse this view and are of the opinion that buying technology is no more difficult.[28] All the major terrorist organisations have small and medium arms, whose provenance is fairly obvious. In the same manner, acquiring AI weapons, based on their increasing relevance and prominence, will not exactly be a tough endeavour.

Policymakers and military institutions are facing competitive pressure to expand the use of military applications of AI. The US, PRC and Russia are important in this regard. On part of the US, experimentation of autonomous boats which can detect and track submarines from thousands of miles is being conducted. Similarly, China is exploring swarm intelligence while Russia is working on underwater drones. Several heads of states and tech giants express simultaneous optimism and despair concerning the rise of AI in modern

[27] Ibid.

[28] Ayoub Kara is an Israeli Druze politician who currently serves as a member of the Knesset for Likud and as Minister of Communications.

times. Putin professed his views about AI as 'the future, not only for Russia, but for all humankind'.[29] In September 2017, he opined to students that the nation which, 'becomes the leader in this sphere will become the ruler of the world'.[30] Nick Bostrom and the late Stephen Hawking also described AI as a potential existential threat to humanity.[31] In recent past, Google cancelled a contract of Project Maven, due to strong opposition of its own employees, with the US Department of Defense which would have to analyse images for detection and tracking for the military. [32] Amazon also refused to sell facial recognition software to the US police. Even Korea Advanced Institute of Science and Technology (KAIST) annulled a project of autonomous weaponry. Campaigns against killer robots are also on the rise.

The aforementioned apprehensions have emerged as major challenges because they possess a tendency to be engulfed by a hyper war scenario. At the same time, it is also important to note the placement of humans in this scenario as most countries are revisiting defence systems and incorporating AI features to meet hyper warfare challenges. August Cole of Atlantic Council argued that, 'Political and civilian liberties are being eclipsed by speedy decision making of machines and most AI algorithms are also being modified and preparing for hyper war like situation'.[33] Security 2040, a project by the Research and Development Corporation (RAND) which was aimed at investigating the probabilities and possibilities of nuclear breakout due to AI, predicts an epoch of hyper war to be near. Given that learning abilities of AI involve some miscalculations it could lead to nuclear hyper war. [34]

Lessons of history have profound rationales for arms race which stem from technological advancement particularly in warfare. Historically, all the

[29] Paul Ratner, 'Putin Weighs in on Artificial Intelligence and Elon Musk Is Alarmed', *Big Think,* 24 September 2017, https://bigthink.com/paul-ratner/putin-weighs-in-on-artificial-intelligence-and-elon-musk-is-alarmed.

[30] Vincent James, "Putin says the nation that leads in AI will be the ruler of the world", *The Verge*, September 4, 2017, URL : https://www.theverge.com/2017/9/4/16251226/russia-ai-putin-rule-the-world.

[31] Nick Bostrom is a Swedish philosopher at the University of Oxford known for his work on existential risk, the anthropic principle, human enhancement ethics, superintelligence risks, and the reversal test.

[32] Project Maven is a Pentagon project involving machine learning and engineering talent to distinguish people and objects in drone videos with Google, which was cancelled by Google.

[33] August Cole is a Senior Fellow at the Atlantic Council.

[34] Security 2040 aims to answer that question by exploring how new technologies, evolving trends and big ideas are shaping the future of global security.

superpowers became and remained superpowers only because of unparalleled technological advancement and this lesson of history and principle of warfare is not going to change. Now, the evolution of technological advancement has arrived at a unique and critical juncture than it ever was during the entire history of humanity. It now involves some exceptional elements that were absent in previous periods of weaponry and warfare. These exceptional elements are the features of AI which have changed traditional approaches of weaponry and warfare. What does AI change in weaponry mean in warfare? It means altering, restructuring and repositioning of weaponry in its nature and form and incorporating AI essentials in order to generate perception, cognition and action. Balance of power will be replaced by balance of transcendence (overlapping intelligence) and nuclear deterrence will be replaced by cognitive deterrence. So, weaponry will not be merely a means of warfare but to some extent it could become the driving force (dependent on extent of autonomy) of warfare.

In order to estimate the future evolution of speed, lethality and reach of AI weaponry there is a critical need to examine AI with reference to the Go game.[35] Go is arguably the most complex board game in existence. Its goal is simple i.e. to surround more territory than the opponents. This game has been played by humans for over 2500 years and is considered as the oldest game in the world. However, it is not only humans that are playing this game now. In 2016, Google's deep mind AlphaGo beat 18 times world champion Lee Sedol in four out of five games.[36] [37] Normally a computer beating a human at a game like chess would not be impressive but Go is different because it cannot be predicted as it has 10 raised to 170 possible moves.[38] To put that into perspective, there are only 10 raised to 80 observable particles in the universe. Alpha was trained using data from the real human Go game. It ran through millions of games and learned the techniques used and even made up new ones that no one has ever seen.[39] However, only after a year of AlphaGo victory over Lee Sedol, a brand

[35] Go is the most complex board game which has been played in China and in East Asia from ancient times.

[36] AlphaGo is a computer program that plays the board game Go. It was developed by Alphabet Inc.'s Google DeepMind in London.

[37] Lee Sedol is a South Korean professional Go player and a world champion.

[38] James Barrat, "Our Final Invention: Artificial Intelligence and the End of the Human Era", *Thomas Dunne Books*, October 1, (2013):64-65.

[39] Ibid.

new AlphaGo Zero beat the original AlphaGo in 100 out of 100 games. The most impressive part was that it learnt with zero human interaction. This technique is more powerful than any previous version because it is not restricted to human knowledge. AlphaGo Zero surpassed the previous AlphaGo in only 40 days of learning and in only 40 days it surpassed 2500 year strategy and knowledge. AI could enhance the speed, lethality and reach of weaponry at this rate that will change every dimension of warfare in the same manner, and if AI weaponry surpasses singularity, it will even catalyse the extinction of Homo sapiens.