A

SEMINAR REPORT

ON

"ARTIFICIAL INTELLIGENCE IN DEFENCE APPLICATION"

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ABSTRACT

The speed of processes and the amount of data to be used in defending the cyber space cannot be handled by humans without considerable automation. However, it is difficult to develop software with conventional fixed algorithms (hard-wired logic on decision making level) for effectively defending against the dynamically evolving attacks in networks. This situation can be handled by applying methods of artificial intelligence that provide flexibility and learning capability to software. This seminar is a brief survey of artificial intelligence applications in cyber defense (CD),and military applications (MA) and analyzes the prospects of enhancing the cyber defense capabilities by means of increasing the intelligence of the defense systems. After surveying the papers available about artificial intelligence applications in CD&MA, we can conclude that useful applications already exist. They belong, first of all, to applications of artificial neural nets in perimeter defense and some other CD areas. From the other side – it has become obvious that many CD&MA problems can be solved successfully only when methods of artificial intelligence are being used. For example, wide knowledge usage is necessary in decision making, and intelligent decision support is one of yet unsolved problems in CD&MA.

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1. INTRODUCTION

It is obvious that defense against intelligent cyber weapons can be achieved only by intelligent software, and events of the last two years have shown rapidly increasing intelligence of malware and cyber-weapons. Let us mention the Conficker worm for example. Some effects of Conficker on military and police networks in Europe have been as follows: "Intramar, the French Navy computer network, was infected with Conficker on 15 January 2009. The network was subsequently quarantined, forcing aircraft at several airbases to be grounded because their flight plans could not be downloaded. The United Kingdom Ministry of Defense reported that some of its major systems and desktops were infected. The virus has spread across administrative offices, NavyStar/N* desktops aboard various Royal Navy warships and Royal Navy submarines, and hospitals across the city of Sheffield reported infection of over 800 computers. On 2 February 2009, the Bundeswehr, the unified armed forces of the Federal Republic of Germany reported that about one hundred of their computers were infected. In January 2010, the Greater Manchester Police computer network was infected, leading to its disconnection for three days from the Police National Computer as a precautionary measure; during that time, officers had to ask other forces to run routine checks on vehicles and people."

Application of network centric warfare (NCW) makes cyber incidents especially dangerous, and changes in cyber defense are urgently required. The new defense methods like dynamic setup of secured perimeters, comprehensive situation awareness, highly automated reaction on attacks in networks will require wide usage of artificial intelligence methods and knowledge-based tools. Why has the role of intelligent software in cyber operations increased so rapidly? Looking closer at the cyber space, one can see the following answer. Artificial intelligence is needed, first of all, for rapid reaction to situations in Internet. One has to be able to handle large amount of information very fast in order to describe and analyze events that happen in cyber space and to make required decisions. The speed of processes and the amount of data to be used cannot be handled by humans without considerable automation. However, it is difficult to develop software with conventional fixed algorithms (hard-wired logic on decision making level) for effectively defending against the attacks in cyber space, because new threats appear constantly. Here is a place for artificial intelligence methods.

1.1 ARTIFICIAL

The simple definition of artificial is that objects that are made or produced by human beings rather than occurring naturally.

1.2 INTELLIGENCE

The simple definition of intelligence is a process to entail a set of skills of problem solving, enabling to resolve genuine problems or difficulties that encounters and to create an effective product and must also entail the potential for finding or creating problems and thereby laying the groundwork for the acquisition of new knowledge.

1.3 ARTIFICIAL INTELLIGENCE

Artificial intelligence is a branch of science which deals with helping machines find solution to complex problems in a more human like fashion. This generally involves borrowing characteristics from human intelligence, and applying them as algorithms in a computer friendly way. A more or less or flexible or efficient approach can be taken depending on the requirements established, which influences how artificial intelligent behavior appears.

Artificial intelligence is generally associated with computer science, but it has many important links with other fields such as maths, psychology, cognition , biology and philosophy , among many others . Our ability to combine knowledge from all these fields will ultimately benefits our progress in the quest of creating an intelligent artificial being.

A.I. is mainly concerned with the popular mind with the robotics development, but also the main field of practical application has been as an embedded component in the areas of software development which require computational understandings and modeling such as such as finance and economics, data mining and physical science.

A.I in the fields of robotics is the make a computational models of human thought processes. It is not enough to make a program that seems to behave the way human do. You want to make a program that does it the way humans do it.

In computer science they also the problems bcoz we have to make a computer that are satisfy for understanding the high-level languages and that was taken to be A.I.

The intellectual roots of AI, and the concept of intelligent machines, may be found in Greek mythology. Intelligent artifacts appear in literature since then, with real mechanical devices actually demonstrating behaviour with some degree of intelligence. After modern computers became available following World War-II, it has become possible to create programs that perform difficult intellectual tasks.

We have witnessed the solving of a number of intelligently hard problems by computers like playing good chess, for instance. During the early days of computing the chess playing was considered a benchmark showing a real intelligence. Even in seventies of the last century, when the computer chess was on the masters level, it seemed almost impossible to make a program that could beat the world champion. However, this happened sooner than expected. This had three reasons: increased computing power, development of a good search algorithm (that can be used in many applications beside chess,), and well organized knowledge bases that included all available chess knowledge (first of all, opening and end games). In essence, the chess problem could be solved because it was a specific intellectual problem belonging to so called narrow AI. A different case is translating from one language into another that requires general AI. In sixties of the last century, especially after N. Chomski's work in structural linguistics, it was expected that the natural language translation problem will be solved soon. It has not happened yet, although success is visible in some specific applications like, for instance, Google's AI linguistics. The reason is that this requires artificial general intelligence -- possessing of and ability to handle large amounts of knowledge in every field related to human activities.

It is generally accepted that AI can be considered in two ways: as a science aimed at trying to discover the essence of intelligence and developing generally intelligent machines, or as a science providing methods for solving complex problems that cannot be solved without applying some intelligence like, for instance, playing good chess or making right decisions

based on large amounts of data. In the present seminar we will take the second approach, advocate for applying specific AI methods to cyber defense and military problems.

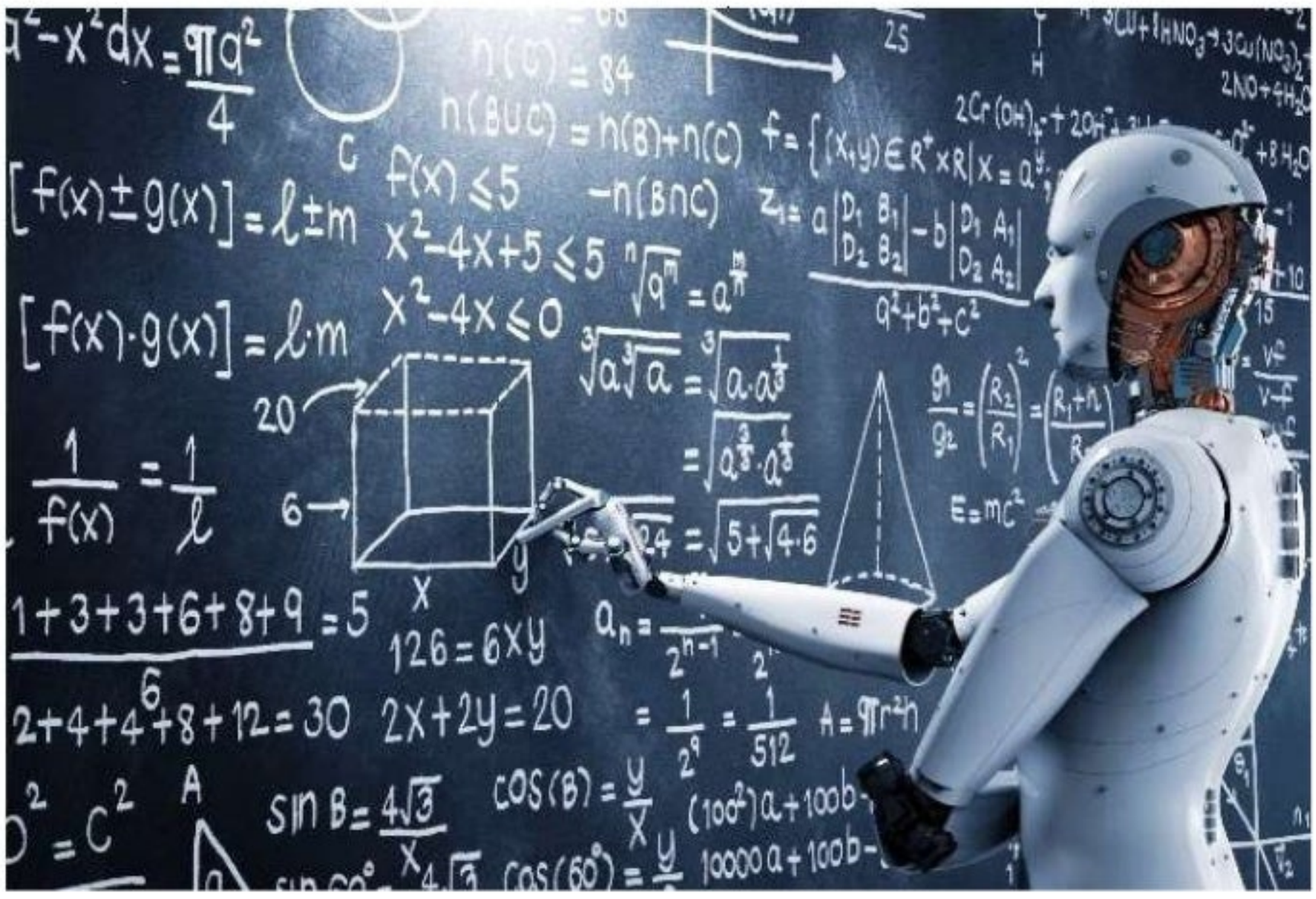

Fig 1.3:Artificial Intelligence

2. WHAT WE HAVE TODAY

After surveying the seminar available about AI applications in CD&MA, we are able to conclude that numerous useful applications already exist in this field. They belong, first of all, to applications of artificial neural nets in perimeter defense. On the other hand it has become obvious that many more CD&MA problems can be solved successfully only when AI methods are used. Wide knowledge usage is necessary in decision making, and the intelligent decision support is one of the yet unsolved problems in CD.

A large number of methods have been developed in the artificial intelligence field for solving hard problems that require intelligence from the human perspective. Some of these methods have reached a stage of maturity where precise algorithms exist that are based on these methods. Some methods have even become so widely known that they are not considered belonging to artificial intelligence any more, but have become a part of some application area, for instance, data mining algorithms that have emerged from the learning subfield of AI. It would be impossible to try to give more or less complete survey of all practically useful AI methods in a brief survey. Instead, we have grouped the methods and architectures in several categories: neural nets, expert systems, intelligent agents, search, machine learning, data mining and constraint solving. We outline these categories here, and we give references to the usage of respective methods in cyber defense. We are not going to discuss natural language understanding, robotics and computer vision which we consider specific applications of AI.

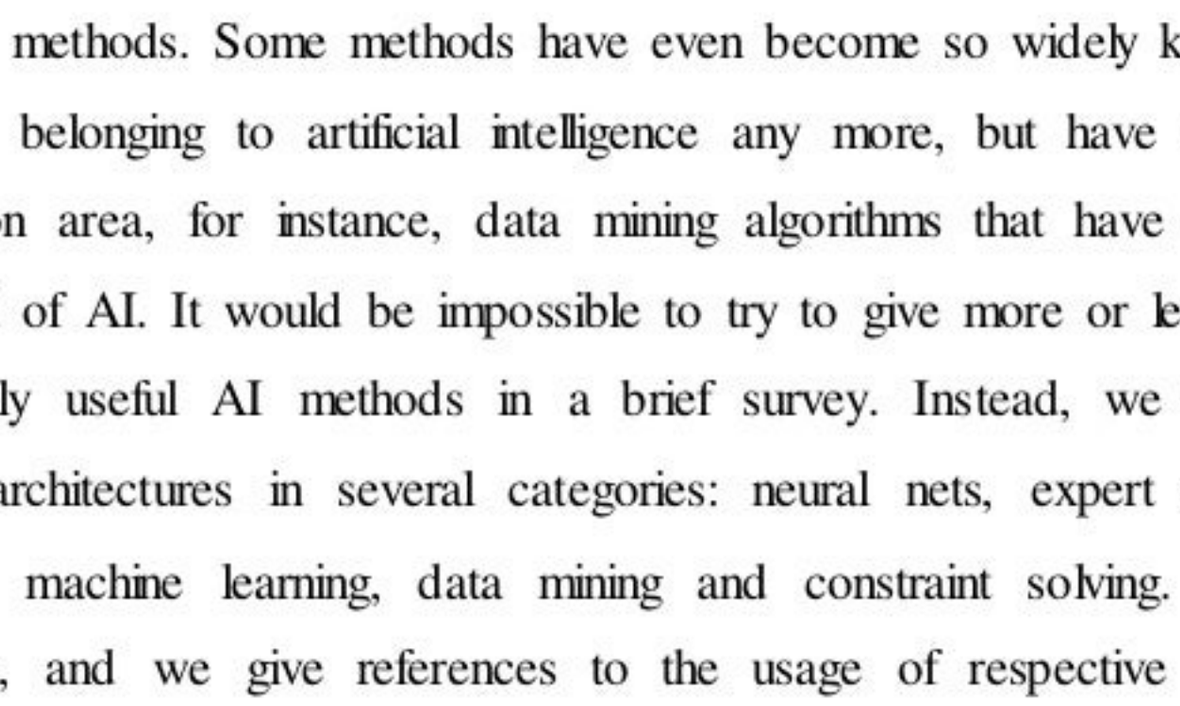

Fig 2:Block Diagram

2.1 NEURAL NETWORKS

Neural nets have a long history that begins with the invention of perceptron byFrank Rosenblatt in 1957 – an artificial neuron that has remained one of the most popular elements of neural nets. Already a small number of perceptrons combined together can learn and solve interesting problems. But neural nets can consist of a large number of artificial neurons. Therefore neural nets provide a functionality of massively parallel learning and decision-making. Their most distinguished feature is the speed of operation. They are well suited for learning pattern recognition, for classification, for selection of responses to attacks etc. They can be implemented either in hardware or in software.

Neural nets are well applicable in intrusion detection and intrusion prevention. There have been proposals to use them in, computer worm detection, spam detection, zombie detection, malware classification and in forensic investigations.

A reason for the popularity of neural nets in cyber defense is their high speed, if implemented in hardware or used in graphic processors. There are new developments in the neural nets technology: third generation neural nets – spiking neural networks that mimic biological neurons more realistically, and provide more application opportunities. Good opportunities are provided by the usage of FPGA-s (field programmable gate arrays) that enable rapid development of neural nets and their adjustment to changing threats.

2.2 EXPERT SYSTEMS

Expert systems are unquestionably the most widely used AI tools. An expert system is software for finding answers to questions in some application domain presented either by a user or by another software. It can be directly used for 98 decision support, e.g. in medical diagnosis, in finances or in cyberspace. There is a great variety of expert systems from small technical diagnostic systems to very large and sophisticated hybrid systems for solving complex problems.

Conceptually, an expert system includes a knowledge base, where expert knowledge about a specific application domain is stored. Besides the knowledge base, it

includes an inference engine for deriving answers based on this knowledge and, possibly, additional knowledge about a situation. Empty knowledge base and inference engine are together called expert system shell -- it must be filled with knowledge, before it can be used. Expert system shell must be supported by software for adding knowledge in the knowledge base, and it can be extended with programs for user interactions, and with other programs that may be used in hybrid expert systems. Developing an expert system means, first, selection/adaptation of an expert system shell and, second, acquiring expert knowledge and filling the knowledge base with the knowledge. The second step is by far more complicated and time consuming than the first.

There are many tools for developing expert systems. In general, a tool includes an expert system shell and has also a functionality for adding knowledge to the knowledge repository. Expert systems can have extra functionality for simulation, for making calculations etc. There are many different knowledge representation forms in expert systems, the most common is a rule-based representation. But the usefulness of an expert system depends mainly on the quality of knowledge in the expert system's knowledge base, and not so much on the internal form of the knowledge representation. This leads one to the knowledge acquisition problem that is crucial in developing real applications. Example of a CD expert system is one for security planning. This expert system facilitates considerably selection of security measures, and provides guidance for optimal usage of limited resources. There are early works on using expert systems in intrusion detection

2.3 INTELLIGENT AGENTS

Intelligent agents are software components that possess some features of intelligent behavior that makes them special: proactiveness, understanding of an agent communication language (ACL), reactivity (ability to make some decisions and to act). They may have a planning ability, mobility and reflection ability. In the software engineering community, there is a concept of software agents where they are considered to be objects that are at least proactive and have the ability to use the agent communication language. Comparing agents and objects, one can say that objects may be passive, and they do not have to understand any language (although they accept messages with well-defined syntax.)

Using intelligent agents in defense, and After solving some legal and also commercial problems, it should be possible in principle to develop a "cyber police" consisting of mobile intelligent agents. This will require implementation of infrastructure for supporting the cyber agents' mobility and communication, but must be unaccessible for adversaries. This will require cooperation with ISP-s. Multi-agent tools can provide more complete operational picture of the cyber space, for instance, a hybrid multi-agent and neural network-based intrusion detection method.

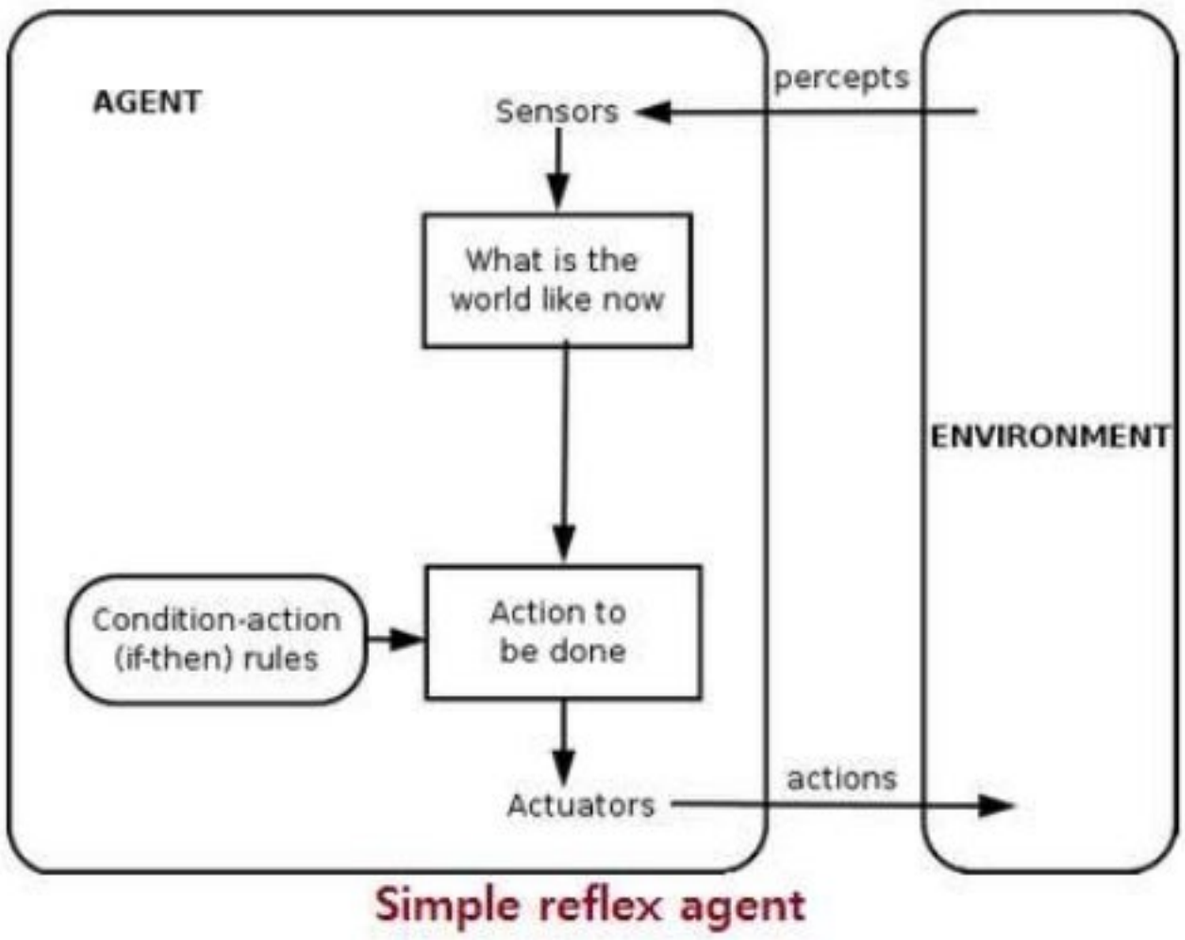

Fig 2.3 Simple Reflex Agent

2.4 SEARCH

Search is a universal method of problem solving that can be applied in all cases when no other methods of problem solving are applicable. People apply search in their everyday life constantly, without paying attention to it. Very little must be known in order to apply some general search algorithm in the formal setting of the search problem: one has to be able to generate candidates of solutions, and a procedure (formally a predicate) must be available for deciding whether a proposed candidate satisfies the requirements for a solution. However, if additional knowledge can be exploited to guide the search, then the efficiency of search can be drastically improved. Search is present in some form almost in every intelligent program, and its efficiency is often critical to the performance of the whole program.

A great variety of search methods have been developed which take into account the specific knowledge about particular search problems. Although many search methods have been developed in AI, and they are widely used in many programs, it is seldom considered as the usage of AI. For example, in and dynamic programming is essentially used in solving optimal security problems, the search is hidden in the software and it is not not visible as an AI application. Search on and or trees, αβ-search, minimax search and stochastic search are widely used in games software, and they are useful in decision-making for cyber defense. The αβ-search algorithm, originally developed for computer chess, is an implementation of a generally useful idea of "divide an conquer" in problem solving, and especially in decision making when two adversaries are choosing their best possible actions. It uses the estimates of minimally guaranteed win and maximally possible loss. This enables one often to ignore large amount of options and considerably to speed up the search.

2.5 LEARNING

Knowledge base or by improving the inference engine. This is one of the most interesting problems of artificial intelligence that is under intensive investigation. Machine learning comprises computational methods for acquiring new knowledge, new skills and new ways to organize existing knowledge. Problems of learning vary greatly by their complexity from simple parametric learning which means learning values of some parameters, to complicated forms of symbolic learning, for 100 example, learning of concepts, grammars, functions, even learning of behavior AI provides methods for both -- supervised learning (learning with a teacher) as well as unsupervised learning. The latter is especially useful in the case of presence of large amount of data, and this is common in cyber defense where large logs can be collected. Data mining has originally grown out of unsupervised learning in AI. Unsupervised learning can be a functionality of neural nets, in particular, of self-organizing maps.

A distinguished class of learning methods is constituted by parallel learning algorithms that are suitable for execution on parallel hardware. These learning methods are represented by genetic algorithms and neural nets. Genetic algorithms and fuzzy logic has been, for instance, used in threat detection systems.

2.6 CONSTRAINT SOLVING

Constraint solving or constraint satisfaction is a technique developed in AI for finding solutions for problems that are presented by giving a set of constraints on the solution, e.g. logical statements, tables, equations, inequalities etc. Asolution of a problem is a collection (a tuple) of values that satisfy all constraints.

Actually, there are many different constraint solving techniques, depending on the nature of constraints (for example, constraints on finite sets, functional constraints, rational trees). On a very abstract level, almost any problem can be presented as a constraint satisfaction problem. In particular, many planning problems can be presented as constraint satisfaction problems. These problems are difficult to solve because of large amount of search needed in general.

3. AI APPLIED TO ROBOTICS

The Artificial Intelligence and Robotics (AIR) group studies theory, algorithms, and systems for making intelligent decisions in complex and uncertain environments. The research covers most aspects of AIR including perception and interpretation of sensor data, learning about environments, learning to make decisions, automated planning and reasoning, and interaction of AIR systems with each other and with humans. The group studies AIR systems for both virtual and physical worlds under varying levels of autonomy, ranging from decision support systems to full autonomy.

3.1 OBJECTIVES AND COMPONENTS OF ROBOTICS

Occupied a special position among the controllable structures, equipments, process systems, those which redeems the role of man in physical and mental activities that previously required human intervention, these are the robots.

The word robot sounds still strange the majority of people perhaps even today, maybe just because they are met with it in the science-fiction literature (which can be considered as the "founding fathers", as they described them together with their imaginable characteristics and types as their permanent player of their work much earlier before its technical implementation) and cinema (e.g. Star Wars movies). The robotics absolutely not a new activity for engineers and professionally dedicated economic experts, as already seek to automate their machinery and their equipment in order to facilitate the people live and work, improving the efficiency of the work since the ancient times dreamily about anthropomorphic auto systems too.

A multidisciplinary technical research area called mechatronics deals with the tasks of robotics implementation in the scientific - technical life. More and more successful results are achieved in almost all areas of life, as a result of the continuous and

synergistic (reinforcing each other's effects), thereby increasing faster development of integrated techniques, as a specially important example of dangerous or very complex tasks for humans, which exceeding the limits of the practical human efforts (e.g. military operations, certain industrial processes, disaster management, space exploration, etc.).

Clarification needed for some of the basic concept circles that belong to the notion of management theory before you begin any discussion of topics, which can sometimes cause complications even for the experts, when they use these carelessly in everyday languages. It is not surprising fact that the topic pioneers (the exponents of science fiction) is at the forefront of creating concepts, because their imagination is mostly based on their scientific and technical skills and knowledge. In addition, it is clearly appreciated that human imagination exceeds the limits of science and technical feasibility in many areas.

Also characteristic feature of the sci-fi literature, that the authors give excessive human characteristics to their robot creations, thus force perplexing and mostly endless thinking on the laic reader, contrary to manipulative options of movies.

3.2 CLOSELY RELATED INTERLOCKING CONCEPTS OF ROBOTICS

- *Control operation* : an operation, which launch, maintain, change, and stop a technical process, equipment, appliance in manual or automatic way.

- *Control engineering*: the control engineering is one of the branches of the technical sciences. This branch is the science of control theory, which deals with the laws of control and its practical implementation.

- *Automatic technology*: deals with the laws and practical implementation of autonomic control (full different from zero in the degree of human intervention) within the control engineering.

- *Automation*: is the technical implementation of theory of automatic technology, economic and technical activity with the substituting of human perception – controlling – and regulating activities by automatic machine process for

maintaining a constant level or increasing of productivity, reliability, and quality, in order to increase process efficiency (productivity). The complex automation means the combined application of automatic regulation and control.

- *Automatic machine*: is a machine that can work automatically.

- *Operation* : is the main phase of the operation and maintenance process, when the machine or equipment of the work procedure is actuated.

- *Impact-chain*: means of the continuous chain of elements (marker – transmitter – relay – sensor – processor – interfering – working – etc. subassemblies) of relationship system between input and output signals of the process.

- *Autonomy*: is the ability to perform tasks without human intervention (unmanned system) starting from the current state and processed the sensed conditions during the execution (according to the impact of operator, it may be gradual or full autonomy).

- *Robotics*: or robot-technique is one of the newest multidisciplinary branch of the technical sciences, deal with theme of creating robots and automating processes by robots.

4. APPLICATION AREAS AND DEVELOPMENT TRENDS OF MILITARY ROBOTS

4.1 THE INITIAL STEPS OF THE USE OF MILITARY ROBOTS

The radio remote control was implemented with radio-controlled ship model for the first time in the world in 1898 by the genius Nicola Tesla during an electrical exhibition at Madison Square Garden in New York.

The first truly successful radio remote-controlled aircraft was an anti-aircraft artillery target version of the De Havilland DH82A,B 'Tiger Moth", the British made "Queen Bee" (420 pieces were made) in 1935.

Fig 4.1(a) :Canadian Soldiers With Captured Goliath

During World War II the advancing German troops to invade France found a small truck in 1940, which was a pioneering invention of the French engineer Adolphe

Kégresse. It was a developed experimental remote-controlled explosive vehicle in 1939. Using this tool, a German engineer Carl Friedrich Wilhelm Borgward developed an armoured destruction equipment in his plant in Bremen in November 1940 (its transporting capacity was 60 kilograms of explosives) the remote mini crawler vehicle Goliath for demolition of fortifications, barricades and armoured equipments. Initially the device was wire-controlled and electric motor-driven, but could operate only less than 10 minutes due to its battery capacity (the Zündapp factory produced approx. 5000 units of improved combustion-engine version with 100 kg load capacity from 1942 until 1945.).

The use of remote control technology for military purposes was improved intensively during the Second World War, with many result of this being such as small destroyer boats, torpedoes, missiles and others. These initial steps have also appeared in other nations' armies (e. g. the Soviets had got also a radio-controlled destroyer vehicle called"Teletank", similar to the German Goliath).

These devices were forgotten after the war, only the appearance of microelectronics, computing, aerospace, and industrial robots came to the fore once again.

Fig 4.1(b): ANDROSTM F6 Mine Rescue Robot

The increasingly effective, advanced military robots are used in diverse military tasks nowadays. The United States is the leading developer-user in this area, with a large

amount of deployed military robot technology in his recent wars; mostly its demolition expert tools and reconnaissance fighter aircraft.

In the case of military robots, unfortunately the most people still associate the combat robots first (as destructive tools), and they do not accept the robot-human warfare from moral and ethical point of view.

This idea is one of the most important dilemmas of fighting robot category, which divides people according to their various political, economical interests and levels of knowledge. The robots are carried out their tasks (detection - analysis - decision - action) according to the above-described the limit level of their autonomy, that will not require human intervention during their operations in its final objective (AI), which ideas still contain a number of inherent unresolved risk factors.

Fig 4.1(c):PREDATOR-C /Avenger/ MM ISR And SA12 Unmanned Aircraft

5. ARTIFICIAL INTELLIGENCE IN ARMED FORCES

The armed forces of the world's leading military powers all recognize the qualitative edge AI systems are likely to give them today and tomorrow – soldiers who often "face problems of scale, complexity, pace and resilience that outpace unaided human decision making."Whether for commanders faced with unconventional adversaries in highspeed engagements; intelligence analysts faced with drawing the correct conclusions from petabytes of noisy data; or frontline soldiers; AI promises to augment analysis and decision-making capabilities and reaction times both, speed up learning, and improve their ability to act with discretion, accuracy, and care under uncertain and changing conditions. It is therefore little surprise that many of world's leading militaries are running active AI development and deployment programs; however, it is the way these AI systems are tailored to underlying needs, which reveals a lot about the evolving strategic and tactical doctrines of these powers – and the changing nature of deterrence and warfare in the decades to come.

5.1 CHINA

As the second biggest 'player' in general-purpose AI China is increasingly showing that it is more than capable of keeping pace with the US in this field. While in terms of fundamental breakthroughs, China is still lagging behind the US, there has been a massive increase in growth in terms of cited (machine learning) research. To spur this, in February 2017, China's National Development and Reform Commission approved a plan to establish an online 'national laboratory for deep learning', commissioning Baidu to set up the research effort which will focus on seven areas of research including machine learning-based visual recognition, voice recognition, new types of human machine interaction and deep learning intellectual property. The overarching goal, it stated, is to "boost China's overall competence in artificial intelligence". Meanwhile, major Chinese companies such as Baidu, Alibaba and Tencent have proven remarkably adept at rapidly iterating over breakthroughs to develop – and deploy – applications of this technology, as well as making remarkable home-grown breakthroughs in fields such as speech recognition or self-driving cars.

These developments are catalyzed by a high-performance computing (HPC) industry which is increasingly self-reliant: after the US government banned the sale of

powerful Intel Xeon processors to Chinese supercomputing initiatives in April 2015, China was able to substitute its own, native-build processors in the design of the Sunway TaihuLight, since 2016 the world's fastest supercomputer.

Moreover, this drive towards AI is spurred on by strong links between private actors and civilian applications on the one hand, and government agencies (specifically the People's Liberation Army - PLA) on the other. Such government support goes all the way to the top: in 2016, China's 13th 5-year plan (2016-20) highlighted the importance of further breakthroughs in AI, as did the 13th 5-year National Science and Technology Innovation Plan. In 2016, the Chinese government announced plans to develop a 100 billion RMB ($15 billion) AI market by 2018. These initiatives have been characterized as part of the "China Brain Plan" an ambitious effort to develop artificial intelligence and deploy it in unmanned systems, in cyber security and for social governance – and for military supremacy – under the umbrella of President Xi Jinping's national strategy of "military-civil fusion" .

5.2 ISRAEL

Israel was one of the first countries to reveal that it has deployed fully automated robots: self-driving military vehicles to patrol the border with the Palestinian-governed Gaza Strip. Next in the IDF's plans is to equip the vehicles with weapons, and deploy them in stages to Israel's frontiers with Egypt, Jordan, Syria, and Lebanon. Meanwhile, the Israeli 'Harpy' anti-radiation unmanned aerial vehicle is claimed to already able to detect, target, and engage enemy radar installations without any human oversight or supervision. Further in the future, the military is looking to form mixed combat units of robotic vehicles and human soldiers.2

Various Israeli companies also claim to apply AI in a number of their defense systems. The former chief of the Israel Defense Forces' (IDF's) Central Command and current head of land systems at Israel Aerospace Industries (IAI), Major General (retd) Gadi Shamni, for instance, told IHS Jane's that the company has spent enormous sums on research and development (R&D) aimed at developing new products to enable the IDF and overseas clients detect and accurately strike time-critical targets. "In an age of big data, this requires a system that can handle such heavy information loads so IAI has developed an automated

system, called Automated Decision Making (ADM), that employs artificial intelligence and robotics to sift through the data and respond to it instantly.

5.3 RUSSIA

While still somewhat lagging behind on its great power rivals in terms of deep machine learning capabilities, the Russian Federation has displayed a steady commitment to developing and deploying a wide range of robotic military platforms, including unmanned ground vehicles (UGVs), with the full backing of its MoD and domestic industries: in January 2017, President Putin called for the creation of "autonomous robotic complexes" for military use.

5.4 UNITED STATES

AI can already dream up imaginary celebrities, so perhaps it can help the Army imagine revolutionary new engine parts or aircraft, too. That's the goal of a new project from the Defense Advanced Research Projects Agency (DARPA), the research wing of the US Defense Department. DARPA wants entrants to rethink the way complex components are designed by combining recent advances in machine learning with fundamental tenets of math and engineering.

AI is increasingly being used to imagine new things, from celebrity facesto clothing (see "The GANfather: The man who's given machines the gift of imagination"). The systems being used to conjure up new ideas are still in their early stages, but they show a path forward. Machine learning is also already used in some areas of design and engineering, but the DARPA project aims to apply it more broadly, and to the crucial task of determining function and form. "We are using very few computational tools," says Jan Vandenbrande, the DARPA program manager in charge. "It's very artisan. One project selected for funding by DARPA is D-FOCUS, from researchers at the University of Wisconsin-Madison and PARC, the research company spun out of Xerox.

D-FOCUS doesn't come up with new designs from scratch but offers up alternatives to existing designs. If the early phase of the design process is automated, a

human designer can explore more design options and compare trade-offs with each option before committing to a potentially very expensive plan, says Johan de Kleer, the PARC lead on the project.

Under the DARPA challenge, software has to come up with designs for machines that can solve classic engineering questions, like how to transport water uphill.

Using hard-coded laws of physics along with functional requirements provided by a human designer, D-FOCUS can explore potential design concepts. For the moving-water-uphill problem, for instance, the system suggested using the Leidenfrost effect—a phenomenon where water droplets on a very hot surface create a thin layer of vapor beneath themselves, causing a repulsive force that makes the water hover above the surface. The researchers admit that this concept is largely impractical, but it is the type of out-there thinking that can push designers to come up with innovative designs.

DARPA has a long history of backing early technologies. The DARPA Grand Challenge was the first long-distance competition for driverless cars, back in 2004, and it kicked off the current boom in self-driving technology. More recently, DARPA funded an Explainable AI (XAI)program to develop new AI systems that were easier for humans to understand.

Mike Haley, Autodesk's senior director of machine intelligence, says AI could expand design beyond boundaries imposed by the bias and groupthink that humans can succumb to. "We are going to think beyond our brains and come up with ideas that we would have never come up with before," Haley says. "It's like having the world's most wonderful mentor."

6. ARTIFICIAL INTELLIGENCE IN WAR FIELD

6.1 UNMANNED COMBAT AERIAL VEHICLE(UCAV OR UAV)

The modern use of artificial intelligence in military are not limited to the battlefields though it is not small part of military. one field of studies for example is to automate a vehicle in long distance way across many land shapes difficulties. the other study that been expected not to be completed before 25 years is to build a robot soldier that can identify Enemies from friends or bystanders this robot soldier should be able to make decisions follow orders kill targets and accomplish missions successfully it will not be used Till they sure that it can do so.

The military gets a lot of benefits from artificial intelligence machine they can help reducing the risk of life loss in war they can do more efficient than regular soldiers also they are less in cost about 10 times then the cost of human soldiers

Unmanned aerial vehicle Unmanned aerial vehicle also known as a unmanned aircraft system us is a machine which functions either by the remote control of navigator or pilot or autonomously that is as a self directing entity

There many different type of UAV's and they have different characteristics depend on their making purpose there are some that must controlled from the ground but other have complex dynamic system for automation. They can be used also for attacks which are the exploration. There are some civil applications like fire fighting and security work. In general they use the used in boring directory or dangerous works.

6.2 IN ROCKET SYSTEM

Epsilon launch vehicle

The Epsilon launch vehicle is a three-stage solid-fuel rocket. It uses the existing H-IIA solid rocket booster as the first stage, and an upgraded version of the upper stage of the M-V launch vehicle as the second and third stages.

The most significant development in the Epsilon launch vehicle is the capability of running autonomous checks supported by artificial intelligence, which will enable rocket-launch control using a desktop computer (in reality, two computers for redundancy). Which is called as "mobile launch control."

Fig 6.1: Epsilon Launch Vehicle

Researchers in Japan hope to make rocket launches a smoother, less expensive process by equipping the next generation of launch vehicles with artificial intelligence.

In this instance artificial intelligence , or AI, equates to greater automation and the ability for the vehicle to better perform self-checkups, both pre- and post-launch. Once proven safe and reliable, an AI system could even assume some on-the-fly control of a rocket's guidance and operations.

6.3 IN WEAPONS

Lethal autonomous weapons (LAWs) are a type of autonomous military robot designed to select and attack military targets (people, installations) without intervention by a human operator. LAW are also called lethal autonomous weapon systems (LAWS), lethal autonomous robots (LAR), robotic weapons, or killer robots. LAWs may operate in the air, on land, on water, under water, or in space. The autonomy of current systems as of 2018 is restricted in the sense that a human gives the final command to attack - though there are exceptions with certain "defensive" systems. Lethal autonomous weapons should not be confused with UCAVs (unmanned combat aerial vehicle) or "combat drones", which are currently remote-controlled by human pilots. (LAWS are considered a subset of combat drones). Even though combat drones can fly autonomously, they do not fire autonomously, but rather by a trained human operator.

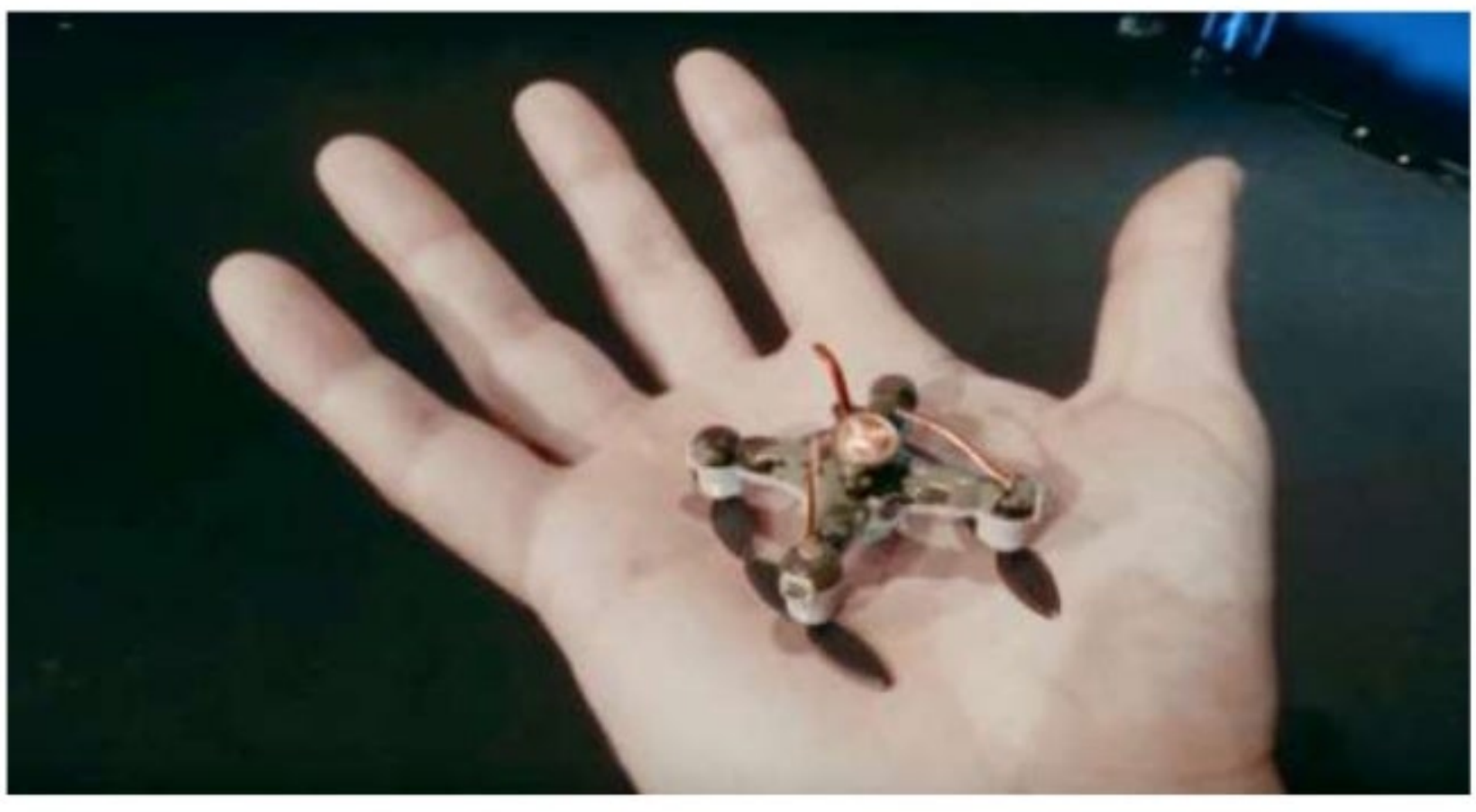

Fig 6.3: Lethal Microdrone

6.4 IN NAVY

The Navy's Littoral Combat Ship may soon be armed with an artificial intelligence-enabled maritime warfare network able to seamlessly connect ships, submarines, shore locations and other tactical nodes.

Fig 6.4: AI in Navy

The Navy is taking technical steps to expand and cyber harden its growing ship-bast ocean combat network, called Consolidated Afloat Networks and Enterprise Services (CANES).

CANES is being installed on carriers, amphibious assault ships, destroyers and submarines, and the service has completed at least 50 CANES systems and has more in production, Navy developers said.

Upgraded CANES, which relies upon hardened cyber and IT connectivity along with radio and other communications technologies, is being specifically configured to increase automation - and perform more and more analytical functions without needing human intervention. It is one of many emerging technologies now being heavily fortified by new algorithms enabling artificial intelligence, senior Navy leaders explain.

Using AI with CANES is part of a series of normal upgrades we could leverage. Anytime we have an upgrade on a ship, we need the latest and greatest. Navy developers (Space and Naval Warfare Systems Command) have a keen eye of what we can build in - not just technology sprinkled on later but what we can build right into automation on a platform. This is why we use open standards that are compliant and upgradeable," Rear Adm. Danelle Barrett, Navy Cyber security Director, told Warrior in an interview. "It can seem like a disconnected environment when we are afloat.

6.5 ROBOTIC CAR

Fig 6.5 Robotic car

An autonomous car (also known as adriverless car, self-driving car, robotic car,) and an unmanned ground vehicle is a vehicle that is capable of sensing its environment and navigating without human input.

Autonomous cars use a variety of techniques to detect their surroundings, such as radar, laser light, GPS, odometryand computer vision. Advanced control systems interpret sensory informationto identify appropriate navigation paths, as well as obstacles and relevantsignage. Autonomous cars must have control systems that are capable of analyzing sensory data to distinguish between different cars on the road.

7. ADVANTAGES AND DISADVANTAGES OF AI

7.1 ADVANTAGES

Dealing with mundane tasks

One massive advantage of artificial intelligence is its potential to complete mundane tasks through intricate automation that will increase productivity. Theoretically this can even remove "boring" tasks from humans and free them up to be increasingly creative.

Faster decisions

Using artificial intelligence alongside cognitive technologies can help make faster decisions and carry out actions quicker.

Avoiding errors

The phrase "human error" was born because humans, naturally, make mistakes from time to time. Computers however, do not make these mistakes – that is, of course, assuming they are programmed properly. With artificial intelligence, data could be processed error-free, no matter how big the dataset might be

Taking risks on behalf of humans

With artificial intelligence, you can arguably lessen the risks you expose humans to in the name of research. Take, for example, space exploration and the Mars rover, known as Curiosity. It can travel across the landscape of Mars, exploring it and determining the best paths to take, while learning to think for itself. Using artificial intelligence in this manner could potentially lead to massive benefits in areas such as demand forecasting, medical diagnosis and oil exploration.

Difficult Exploration

Artificial intelligence and the science of robotics can be put to use in mining and other fuel exploration processes. Not only that, these complex machines can be used for exploring the ocean floor and hence overcoming the human limitations. Due to the programming of the robots, they can perform more laborious and hard work with greater responsibility. They do not wear out easily.

7.2 DISADVANTAGES

If robots start replacing human resources in every field, we will have to deal with serious issues like unemployment in turn leading to mental depression, poverty and crime in the society. Human beings deprived of their work life may not find any means to channelize their energies and harness their expertise. Human beings will be left with empty time.

Secondly, replacing human beings with robots in every field may not be a right decision to make. There are many jobs that require the human touch. Intelligent machines will surely not be able to substitute for the caring behavior of hospital nurses or the promising voice of a doctor. Intelligent machines may not be the right choice for customer service.

One of the major disadvantages of intelligent machines is that they cannot be 'human'. We might be able to make them think. But will we be able to make them feel? Intelligent machines will definitely be able to work for long hours. But will they do it with dedication? Will they work with devotion? How will intelligent machines work wholeheartedly when they don't have a heart?

8. CONCLUSION

AI is at the centre of a new enterprise to build computational models of intelligence, and to solve complex problems in military which is not possible by human.The main assumption is that intelligence (human or otherwise) can be represented in terms of symbol structures and symbolic operations which can be programmed in a digital computer. There is much debate as to whether such an appropriately programmed computer would be a mind, or would merely simulate one, but AI researchers need not wait for the conclusion to that debate, nor for the hypothetical computer that could model all of human intelligence. Aspects of intelligent behaviour, such as solving problems, making inferences, learning, and understanding language, have already been coded as computer programs, and within very limited domains, such as identifying diseases of soybean plants, AI programs can outperform human experts. Now the great challenge of AI is to find ways of representing the commonsense knowledge and experience that enable people to carry out everyday activities such as holding a wide-ranging conversation, or finding their way along a busy street. Conventional digital computers may be capable of running such programs, or we may need to develop new machines that can support the complexity of human thought.

Weapons with artificial intelligence will be one of the most strongest weapon in military, which can identify the targets itself and can make a decision weather to destroy or not.

Overall artificial intelligence is one of the most advantageous technology in defense sectore

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