THE USE OF ROBOTS IN MILITARY OPERATIONS

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Abstract: *Technological developments of the past decades made it possible for UAVs to become really effective weapon systems. Autonomic artificial intelligence as weapons can be visualized as humanoid machines of the apocalypse directed by humans who developed them. They may however easily grow over this level as their appearance in the military and non-military operations create new aspects, concepts and needs for the developers to follow. They are present in battle as well as in our cities, in IT and the virtual world, practically everywhere. Their becoming an important factor of future development in military and non-military technology as well as the society, organizations and governance is no fiction but fact.*

The article, with the help of a couple of examples, will try to illustrate how many-folded the use of robots in our societies are, how they can help solve more and more of our problems and tasks, and how they generate newer and newer thoughts in us.

Keywords: *military technology, innovations, weapon systems, military research, UAV, drone*

1. INTRODUCTION

The development of technologies, the application of research results, the appearance of new, more and more complex machines do change our lives from day to day. But they are changing the face of war too. Military robots, the application of semi-independent and (almost fully) independent tools for military purposes is not any more only a fantastic vision in the minds of some sci-fi authors but everyday reality. Unmanned aerial vehicles comprise probably the military equipment of the most versatile use present in the arsenal of modern warfare. It is becoming more and more believable an idea that in the very close future battles, even wars can be fought by robots and mercenaries between not only nation states or their alliances but also but also between irregular groups, terror organisations, international criminals or more traditional political or economic units of all types and levels.

Present research makes it realistic that autonomous systems (drones) will soon be the most widely utilised tools of warfare [4]. Such autonomous complexes, equipped with artificial intelligence and weapon systems, may be very different from the imaginary humanoid machines with a weaponry of apocalyptic effectiveness, construed and directed by mother-born humans. They can take practically any other practical size and form too – they can be wheeled, winged, or tracked, swimming, rolling or flying equipment, of any form and practically of any function.

Even remote control is becoming less and less necessary, even sometimes dangerous if precision is required – fully automated, autonomous, self-directing "intelligence" is practically available or very close to realisation for any purposes and all sizes of machines from giants down to the nano robots capable of executing pre-programmed actions even within the human body. Artificial intelligence is gaining field from medicine to production, from farming to physical exercise, from birth control to mass destruction in human fantasy as well as in the everyday realities of postmodern urban life. It can save and nurture life or destroy the living.

Their utilisation in the military sphere is no longer fiction but fact. They are present in peace keeping as well as in combat action, in urban warfare as well as in the digital battlefield. Such robots comprise an integrated part of the armoury of the modern national and allied forces and provide for much of their capabilities helping to gain the upper edge at battle. They are typically optimised to their tasks all way down to the choice of (in most cases either silicon-based or natural) materials. The existence of such technologies raise not only engineering questions but also those of jurisdiction and utilisation [1][22].

2. ROBOTS IN MILITARY ACTION

The growth of operative speed means that the attacked have less and less time to answer in kind. Defence therefore is more and more forced to apply preventive action to avoid destruction. The application of robot technology may easily lead to the creation of a well-greased on-going mechanistic system aimed at the annihilation of life. Everything can be controlled and monitored, as the context requires rapid and exact decisions as well as precise and effective execution. The development of autonomous wars is further helped by certain tendencies in developed, urban, postmodern societies:

- Technology, due to mass production and miniaturisation is becoming more and more cost-effective.
- A number of cultural developments – among them the mass education and the Internet providing all social layers with knowledge and information, ideas and ideals – strengthen the belief that (biological, i.e. human and non-human) life is valuable, human life being the non plus ultra realisation of value as such.
- It is becoming a core value of democracies that the society is expected to provide the necessary environment and inputs for the individual to live a meaningful life.
- Machines, robots are at least ethically valued to be worth less than human life.
- Machines, due to the rapidly developing IT technology, are faster in sensing, measuring and analysing (in pre-programmed ways) much larger sets of data than those any human being may process, therefore their reaction may follow faster.
- Wear and tear is a lesser problem for well-construed machines than for human beings.
- Machines remain in function under extreme weather conditions or other environmental pressures where human beings could not.
- Machines, unlike people, do not get tired, can handle monotonous processes quite well, do not feel fear or headaches, etc.

In plain English, machines require less and offer more than people. They are also better subordinates, following orders without questioning them (unless programmed otherwise). No wonder that some of the most important projects in defence research are to do with the development of robots and unmanned vehicles. As newer and newer solutions appear, drones are taking over those jobs that used to be done by man or man-run machines, or offer an opportunity to reduce human risks in the execution of dangerous tasks.

The range of possibilities is wider than wide – news speak about robots deactivating bombs, mini unmanned research submarines, reconnaissance planes and helicopters as well as precision attacks executed by unmanned aerial vehicles. All these tools execute their tasks under close human control. Even if their operators do not have to be present in the area of the activities, their active cooperation is needed at the time of action.

All these tools have to be prepared for their tasks. The preparation requires the professional cooperation of engineers and other specialists sharing the room with the tool. The ongoing IT revolution and the appearing new technologies make it possible that unmanned tools are not only becoming cheaper but also widely used. The computers taking over the burden of analysis and programmed decisions are becoming not only faster and smaller, but more and more powerful too – they are able to execute complex computations with an unimaginably huge amount of data in an unimaginably short time. A combination of modern sensor systems, the fast dataflow technology, small sizes and the extremely exact navigation revolutionised automatization by the end of the 20th century.

The development of artificial intelligence that makes the evolution of automated machines into autonomous ones is a trend in military development that is hard to neglect. It is but responsible thinking to try and model what effects they will have on war in the close future and what challenges they may mean to today's national and home defence, and in general security as such. Opportunities of their application from nano systems in the bodies of soldiers informing the command centre about their readiness to automated circular defence systems of warships are practically endless [1][3][4][22].

2.1 PD-100 Black Hornet

A PD-100 Personal Reconnaissance System, that can be smaller than the flat of the hand, is ready for action within a minute and, in fact, the whole equipment consisting of a flying unit and a terminal fits into a pocket-size holder. It looks like some toy but it is much more than that … due to the micro cameras installed, the 18 gr flying unit is a well-equipped spying tool that can provide crucial visual information about whatever happens behind a corner or a wall. It is quiet, difficult to spot, and relatively fast. The operator can be about 1 km away from the place of action. Its board computer is capable of both directed and independent flight. Various versions of the Hornet are in use in reconnaissance as well as any other type of intelligence operations. It can be used for search, salvage, monitoring, scouting etc. in the open as well as in closed space.

FIG. 1. The Black Hornet [21]

Its use is safe for both people and other aerial vehicles, therefore there is practically never any need for previous air traffic coordination [14][19][20].

2.2 BigDog

The quadruped robot called “Big Dog” looks like a mule (Fig. 2.), approximately 0,91 meters long, 0,76 meters tall and weighs 110 kg. It is developed to provide logistical units where the conventional transport vehicles are not able to operate. The hydraulically operated legs are articulated as other animal’s legs that contain damping elements which absorb the energy of the blows from steps and it recycles them in the next step. The maximum speed is 6.4 km/h and it is able to overcome on a 35-degree slope. The robot is able to go through snow, water, and rocky terrain. Even in rocky terrain it is able to climb muddy natural paths and deliver a maximum 150 kg of additional weight.

FIG. 2. The BigDog [17]

The on-board computer is able to follow its operator from a distance, and control the Big Dog’s movement. The robot’s resource is a two-stroke single-cylinder water-cooled engine. You can find the following sensors which provide the on-board movements: GPS, gyroscope, camera (stereo vision system), LIDAR (follower DPR), engine temperature, speed, hydraulic pressure, temperature, position, dynamometer, battery charge measuring sensors, and so on…

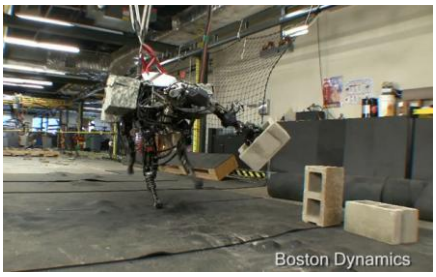

FIG. 3. Modified BigDog [16]

A modified version is equipped with a robot arm (Fig. 3.) in this case it is able to lift up heavy objects. The movement of arms, legs and body is helped by the whole system, like it happens with people and animals [11][12][21].

2.3 Daksh

The Daksh is an electric powered remote controlled vehicle. Its primary function is to secure, localize dangerous objects (eg.: car bombs, lonely suspicious packages), and make easier the handling and destruction of these dangerous objects (Fig. 4.). (This is not the only one device which is developed for these tasks, for example [10] similar purposed robots can be found.)

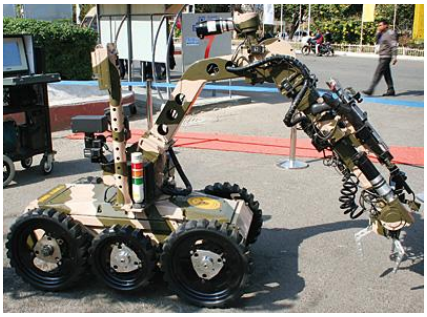

FIG. 4. The remote controlled vehicle, The Daksh [2]

The device can be remotely controlled from 500 meters distance, its arm is able to extend and remove the IED's (for example: 20 kilograms of hazardous material is possible to remove in the distance of 2.5 meters, and 9 kilograms of hazardous material is possible to remove in the distance of 4 meters.) The robot runs on thick rubber wheels which resist of the air pressure of the explosive charge. The UGV is able to climb stairs, blasts closed doors, get over steep hills, maneuver in tight spaces, and tow suspicious vehicles from busy locations. The vehicle contains water cannon and the robot is able to safely destroy UAVs with it. For the operator it is available an X-Ray machine, which has the option to inspect packages and vehicles. The identification of IED's is based on the X-Ray machine's image processing software. The robot is equipped with a camera, IED control equipment, NBC reconnaissance system, and large-caliber shotgun. From the managing station (MCS Master Control Station) one operator control the Daksh with a remote control. The parts of the equipment are the transport vehicle is, which has been specially designed to Daksh, the managing station, its six main operating personnel, and necessary devices to disarm the bombs, and equipment for the transportation of dangerous goods. There is a separated cabin which has the correct equipment to transport the disarmed bombs [1][2].

2.4 General Atomics MQ-9 Reaper

For the purpose of Air Force the UAVs appeared such as modernized version of Predator called MQ-9 Reaper (Fig. 5.) which is for collecting the information, observing the enemy positions, and perform the Air Force offensive tasks. Or Global Hawk (compared to the performed missions) which replaced the famous U-2 spy aircraft. And the micro,- nano-sized devices appeared too. The MQ-9 Reaper is a medium-altitude, long-range, armed and used for several purposes, without turbo-prop unmanned aircraft, which is capable of both remote controlled and autonomous flights. The significant flight time and onboard a long-range sensors and a multi-mode communications systems and precision weapons provide a unique capability to autonomously perform complete destruction process (search, defining, tracking, target definition, implementation and evaluation). The tasks of those drones, which destroy primary dynamic targets, are intelligence, surveillance (data collection), reconnaissance, ground troops or air support, combat search and rescue tasks, precision strike, convoys surveillance, target designation, flight management stations, etc. Onboard weapons can be: GBU-12 Paveway II laser-guided bombs, AGM-114 Hellfire II air-to-surface missiles, AIM-9 Sidewinder or the GBU-38 JDAM and the future of AIM-92 Stinger can be place to get on-board arsenal.

FIG. 5. The MQ-9 Reaper [6]

The Reaper is part of an UAV system that is more like an airplane. The whole system includes unmanned aircraft with weapons and sensors, a ground control station, (PPSl satellite connection), reserve equipment, and operators and technical personnel up to 24-hour duration of the operations. The basic two-person staff is the ground crew from the pilot and sensor operator who operates the sensors and weapons [1][2][6].

2.5 Global Hawk

The Global Hawk (Fig. 6.) is a high altitude and range unmanned aerial vehicle which provides near real-time reconnaissance, surveillance and intelligence information for the commanders and it has the ability to move over a large geographical area and detect patrols moving target and designate target. Considering the dimensions of a 39.9-meter wingspan, 14.5 meters long, 4.7 meters high, 14 628 kg maximum take-off weight (1360 kg payload) aircraft that can fly a maximum height of 18.3 km, the range is 22780 km.

FIG. 6. Global Hawk [18]

The Global Hawk system allows US forces to dominate from the low level of peace-building operations to high intensity warfare operations. The board placed advanced AN/ZPY type-2 (equipped with phased antenna) radar (independently from the weather) has the ability to observe moving and stationary targets and provide to the leadership real-time information in the struggle [7][18].

2.6 Goalkeeper

Originally developed in 1979 and still today used Goalkeeper is a completely automated weapon system, which is used to protect warships against to the missiles, aircraft and surface swimming vehicles (against any threat of water above the surface). [17] literature shows similar systems.

FIG. 7. The Goalkeeper Defense Weapon System [1]

The system is able to execute detection and monitoring as well as destruction. It uses a dual locator system to identify and prioritize targets and attack the highest priority threat. It is equipped with a GAU-8/A Avenger 30 mm Gatling gun used also on the A-10 Thunderbold II aircraft. The high precision seven-barrel cannon offers full round defence and is capable of executing 4200 shots per minute [1][17].

3. SHOULD WE HAVE OUR OWN…?!

As the technology is developing, the drones take over sooner or later all of those missions which are operated directly by human powered tools, and help in all those tasks which have great risk in the human life. Nowadays we use robots which are operated by direct human supervision and control; till mini submarines, reconnaissance helicopters operated from boat deck, and active aircrafts which works in high attitude.

The technological developments show some application possibilities where to lead the engineering creativity and knowledge. A few technology obstacles the robots show us raises a few questions with the operations, as:

- Are the robots able to destabilize the military balance, are they warning or encouraging outbreak of war? Does it influence the arms race which are increasing their technological innovation (is it the compulsion to pre-attack, the cheap micro,-nanosystems using for mass, ability for fast action, and so on…)?
- Is it a real danger that these robots can be available for high accuracy/precision planned missions and built tools, or NBC, weapons of mass destruction used by terrorist or Rogue States? (Included in this are threats of individual terrorist attacks or robots carrying weapons of mass destruction used as a vessel against random targets).
- Is there any chance that the belligerent parties or warring parties take obligatory any law, rules?
- Who controls the ,,daily routine of the battle field", RoE (Rules of Engagement)? (aggression, ….)
- Is it possible that the decisions are made by the executors?
- The robot tools remove/dissuade conflicting interest from wars including making warfare cheaper or increase the probability of the outcomes of the conflicts where weapons are used?
- And so on… [21]

All these technologies such as lasers, microwaves, sonic waves, microbiology, genetics, etc... have in general an aim to enhance quality of human life, health, or in contrast technology can be used against human life. Their owners, installation, starting to apply in the military system never be controlled or planned in every part. Nowadays we can say that technology cannot be used anywhere only in a well-equipped laboratory.

This technology works with special tools, devices and/or unordinary big amount of electrical energy.

It is true that forming this developed technology into weapons requires adequate developed industrial and knowledgeable background which today exists; however, limited.

Despite what we think the increasing use of smaller sized weapon autonomous systems decrease the military stability. The evolving application of weapons and its spreading (dissemination) can happen and they will be widely used in the military mission and we have to calculate that it will also be available for terrorist.

Against this background (knowing these) people who are planning future operations and implementing them need to count on "having our own"; principle regardless of dimension of the battlefield (real or virtual space, missile defence system, or "cyber" defence capability, etc). The main factor is related to education and training, which should become an integral part of military service. We do not decide who our enemy is by what kind of means, strategy, preparedness, and qualifications they have. We have the responsibility for our own system design, installation, and operation; to prepare our soldiers to for war. With the improvement of training we should give such opportunities and capabilities into the hands of decision-makers, where well thought out and responsible decisions can be made. For them it should be clear that the future is not just how we solve the problems in the current location, but it is also the possibility to improve their knowledge [1][7][23].

SUMMARY

The developments of the past few years have changed the mode of the use of the armed forces. These instrument systems continue to be used in military technology.

The systems are configured into developmental tools; as a result robots are not intelligent. Their sentient beings of human values, with a silicon shell. They have more advanced computing performance that can provide opportunities that in situations such as prediction, detection, adaptation and decision-making skills which also are significantly increasing.

What is more important, the combat role of robotic powers having to make the decisions over life and death by the press of a button, or substituting the trained soldiers whose health won't be at risk and families won't have to worry? At a glance, a simple and logical step it seems but with the technological barrier it can reduce the armed forces application psychological barrier.

Scientists say maybe in the near future artificial intelligence level of development reaches to the level of the drones. Allowing man to take independent decisions which may have an impact on life and death. Attacks will be decided within fractions of a second, and this type of operation will occur frequently. The learning comes from software and hardware systems, it's important for appropriate authenticity, and accuracy. Even if the technology development level never reached the human level the deficiencies compensated manoeuvrability, pre-programming, and other characteristics. A few random examples can be seen that the engineering ingenuity and knowledge of what it can do in the future. Opportunities and capabilities that give into the hands of decision-makers, which are well thought out and responsible decisions can be made only to those who are in front of the future. It's not just a management problem in the current location, but also the possibility of the development of the knowledge-encompassing responsibility [5].

REFERENCES

[1] B. Merrill, *Is the Future of War Autonomous?* (online) url: http://www.makeuseof.com/tag/future-war-autonomous/ (2016.02.06);

[2] *Army's First Mobile Robot*, (online) url: http://www.spslandforces.com/story.asp?id=157 (2016.04.01)

[3] B. Békési and P. Szegedi, *Gondolatok a jövőbeni fegyverek alkalmazási lehetőségeiről*, XIV. Természet-, Műszaki- és Gazdaságtudományok Alkalmazása Nemzetközi Konferencia, Szombathely, Magyarország, 2015.05.16. Nyugat-magyarországi Egyetem (NYME), 2015. pp. 183-188. (ISBN:978-963-359-053-9);

[4] B. Békési and P. Szegedi, *Napjaink fegyverrendszer fejlesztési trendjei*, Economica (Szolnok) 2015. (4/2. szám), pp. 158-168. (2015);

[5] B. Békési and P. Szegedi, *Napjainkban fejlesztett fegyverrendszerek megjelenése a jövő hadszínterein, tudás alkalmazás és fejlesztés szempontjából*, Repüléstudományi Közlemények (1997-től) 2015/3, pp. 105-116. (2015);

[6] Constantine H. Houpis, Stuart N. Sheldon, *Linear Control System Analysis and Design with MATLAB®*, CRC Press, Sixth Edition, 2014. (online) url: https://books.google.hu/books?id=R07OBQAAQBAJ&pg=PA27&lpg=PA27&dq=buddyaser,+convoy/raid+overwatch&source=bl&ots=gMfQbdnYe5&sig=xHfcR59pB7Z9PhaJc_Kv3GmC3ds&hl=hu&sa=X&ved=0ahUKEwiViNG71ZLLAhVhCpoKHReJAdcQ6AEIIjAB#v=onepage&q=buddy-laser%2C%20convoy%2Fraid%20overwatch&f=false (2016.02.19);

[7] *Weapons systems Introduced Since Desert Storm (1991) that are available now (2003)*, (online) url: http://www.iwar.org.uk/military/resources/ndu/systems-for-iraq.pdf (2016.04.08);

[8] A.F. Varga, *Robottechnológia és erőalkalmazás,* Hadmérnök, VIII. évfolyam, 2. szám, 2013, (online) url: http://www.hadmernok.hu/132_06_vargaaf.pdf (2016.04.08);

[9] A.L. Barabási, *A hálózatok tudománya*, Libri Kiadó, 2016 ISBN 978 963 310 787 4 p. 446;

[10] Ministry of Defence, *Latest counter-IED equipment showcased*, (online) url: https://www.gov.uk/government/news/latest-counter-ied-equipment-showcased (2016.04.08);

[11] A. Degeler, *US military's LS3 robotic mule deemed too loud for real-world combat.* (online) url: http://arstechnica.co.uk/information-technology/2015/12/us-militarys-ls3-robotic-mule-deemed-too-loud-for-real-world-combat/ (2016.04.08);

[12] O. Solon, *The robot army of the future - from killer drones to cyborg super soldiers* (online) url: http://www.mirror.co.uk/news/technology-science/technology/robot-army-future---killer-5053344 (2016.04.14);

[13] N. Friedman, *Unmanned combat air systems. A new kind of carrier aviation*, Naval Institute Press, Annapolis, Maryland, 2010. (ISBN 978-1-59114-285-0);

[14] *PD-100 Black Hornet Nano Unmanned Air Vehicle*, United Kingdom, (online) url: http://www.army-technology.com/projects/pd100-black-hornet-nano/ (2016.04.14);

[15] Boston Dynamics, *BidDog Overview*, (online) url: http://www.bostondynamics.com/img/BigDog_Overview.pdf (2016.04.01);

[16] E. Ackerman, *BigDog Throws Cinder Blocks with Huge Robotic Face-Arm* (online) url: http://spectrum.ieee.org/automaton/robotics/military-robots/bigdog-throws-cinder-blocks-with-huge-robotic-facearm (2016.04.01);

[17] *Big Dog*, (online) url: http://www.robothalloffame.org/inductees/12inductees/bigdog.html (2016.02.19);

[18] Northrop Grumman, *RQ-4 Block 40 Global Hawk*, (online) url: http://www.northropgrumman.com/Capabilities/GlobalHawk/Documents/Datasheet_GH_Block_40.pdf (2016.04.01);

[19] M. Nicol, *The Black Hornet - tiny spy drone that can follow enemy targets all the way home* (online) url: http://www.dailymail.co.uk/news/article-2272590/The-Black-Hornet--tiny-spy-drone-follow-enemy-targets-way-home.html#ixzz2JpyDCbiL (2016.04.14);

[20] P. Szegedi, *A pilóta nélküli repüléshez kapcsolódva... Tanulmány a pilóta nélküli légijárművek működésével és üzembentartásával kapcsolatban,* p.: 80, ISBN 978-963-12-5224-8, 2016 https://m.ludita.uni-nke.hu/repozitorium/bitstream/handle/11410/10148/Tanulmany_Szegedi_P%C3%A9ter.pdf?sequence=2&isAllowed=y (2016.04.01);

[21] B. Békési and P. Szegedi, *A nanotechnológia lehetséges katonai alkalmazásai*, Műszaki tudomány az Észak-Kelet Magyarországi régióban 2016, Debreceni Akadémiai Bizottság Műszaki Szakbizottsága, 2016. 799 p. pp. 592-601. (ISBN:978-963-7064-33-3);
[22] P. Szegedi and B. Békési, *Sensors on Board of the Unmanned Aerial Vehicles*, Proceedings of 19th International Scientific Conference Transport Means, Kaunas, Litvánia, 2015. 781 p.;
[23] P. Szegedi, and H. Tircsi: *Nanotechnológia a katonai vezetés új kihívása?* Hadtudományi Szemle, 2017. X. évfolyam, 1. szám pp.: 491-505 (2017.04.06).