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VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

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A KOMUNIKAČNÍCH TECHNOLOGIÍ

DEPARTMENT OF FOREIGN LANGUAGES

ÚSTAV JAZYKŮ

ROBOTS OF THE PRESENT AND THE FUTURE

ROBOTI PŘÍTOMNOSTI A BUDOUCNOSTI

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Abstrakt

Potenciál robotů je neomezený, se správnou myšlenkou a dostatečnými prostředky, kdokoli může dosáhnout téměř cokoli. Automatizaci už lze vidět v každém odvětví. Roboti efektivně plní každodenní úkoly doma i v práci. Jednoho dne už možná nebudeme muset ani chodit do práce, protože vše bude automatické od denních rutin, jako je nastavení budíku po řízení auta. Robotika není nový obor. Je tu už nějakou dobu. V průběhu let vědci vyřešili mnoho problémů, ale skutečný problém by mohl být teprve před námi, a bude to správné zvládnutí Singularity. Další výzvou pro vědce bude vyřešení prodloužení života, kterého lze dosáhnout modifikací těla, nebo dokonce dosažení nesmrtelnosti pomocí převedení mysli do její digitální verze a možná taky jejího následného stažení do mechanického těla.

Klíčová slova

Roboti, Robotika, Drony, Singularita, Kyborgové, Transcendování, Digitalizace vědomí, Prodloužení délky života

Abstract

Potential of robots is limitless, with the right idea, and sufficient resources anyone can accomplish almost anything. Automatization can be seen across every industry. Robots are efficiently completing everyday tasks at homes and work. One day we might not need to go to work anymore as everything will be automatic from daily routines like setting the alarm to driving a car. Robotics is not a new field. It has been here for some time already. Through the years scientists fixed many issues, but the real problem might be just ahead will be managing the Singularity properly. The next challenge for scientist will be dealing with the lifespan extension possibly achievable through body modification or even achieving immortality through digitalizing one's mind and perhaps downloading it to the mechanical body.

Keywords

Robots, Robotics, Drones, Singularity, Cyborgs, Transcendence, Digital mind, Lifespan extension

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Prohlášení

Prohlašuji, že bakalářskou práci na téma Roboti přítomnosti a budoucnosti jsem vypracoval samostatně pod vedením vedoucí závěrečné práce a s použitím odborné literatury a dalších informačních zdrojů, které jsou všechny citovány v práci a uvedeny v seznamu literatury na konci práce.

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V Brně dne 31.05.2022 .....

Jozef Rehák

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1. Introduction

Robots are perfect tools for reaching goals that the humankind previously could not imagine. Nowadays, these machines are able to provide support in everyday life in many previously impossible ways. Robots can now help with everyday routines around household, spy on and engage a target in a hostile area using advanced military technology or explore places where human beings are unable to go. With the help of A. I. (Artificial Intelligence), the robots could very soon become so sophisticated that there would be no need for us to control them directly, and everything could become automated. Considering the influence of the I. o. T. (Internet of Things), robots would practically function without us ever checking up on them again. Development of these machines is moving fast, and nobody can say with absolute certainty what kind of future awaits us with their constant evolution. They could become a threat or perhaps replace us in every possible work or labour and strip us of the need to work.

The main goal of this thesis is to present robots with their fundamental problems, threats they may pose, as well as list and describe their types and uses. The first part will describe what actually does the word robot mean, how did robots get their name and a brief overview of the history of robots. The second part will list the categories of robots according to their possible usage as well as show the variety of their uses and then present some of the robots that belong to these categories in more detail. The third part will deal with the future of robotics, their evolution that might bring us to extinction in case of reaching the point of singularity or make the world an entirely different place. There is even a possibility that the human lifespan could be enlarged through advanced usage of robotics. The nanorobots will be discussed at the end of this thesis. The creation of advanced nanorobots is likely to become the next significant step in robotics as their potential is superior to any technology that robotics currently possesses. Why are nanorobots so important? The potential is in their scale as a nanorobot is so miniature that it can enter our body on a subcellular level and possibly alter our cells and maybe even D. N. A. (Deoxyribonucleic Acid). On the other hand, not every human being might be so excited about creation of such advanced technology, because every technology can be used for helping humankind as well as pose as a threat to safety of people. Recent situation with people and vaccines for COVID-19 showed that people tend not to trust new scientific advancements, particularly if the advancement arises fast. Therefore, maybe humankind is not ready for such advancement yet. Hopefully, the future of robotics holds easier integration of new technological advancements.

2. The history of robots

What is a robot? According to Moravec (2021), a robot is any automatically functioning machine which substitutes human actions. The name "robot" was derived from the word "robota" which means forced labour. It made its first appearance in science fiction drama R.U.R (Rossum's Universal Robots) written by the novelist Karel Čapek. Čapek initially wanted to name robots "labori" instead of "roboti", using Latin root for labour. It was later changed after the recommendation of his brother Josef Čapek to use "roboti".

Moravec (2021) also points out that:

> The word robotics first appeared in Isaac Asimov's science-fiction story Runaround (1942). Along with Asimov's later robot stories, it set a new standard of plausibility about the likely difficulty of developing intelligent robots and the technical and social problems that might result. Runaround also contained Asimov's famous Three Laws of Robotics:
>
> 1. A robot may not injure a human being, or, through inaction, allow a human being to come to harm.
>
> 2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.
>
> 3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

However, many argue that the three laws are not an acceptable solution for robots. Salge (2017) suggests a different approach to this problem, using an alternative concept of empowerment of the robots instead of making robots helpless synthetic creatures unable to act when needed. Salge (2017) further explains that this empowerment is the ability to affect a situation and being aware of the possibility to act. After simulating various scenarios in which robots would react using this empowerment principle, the robots surprisingly acted in a very natural way. Salge (2017) claims that in order to keep people safe, robots need to maintain human empowerment as well as their own.

2.1 Past evolution of robots

According to Moravec (2021), the first modern robot was a stationary industrial robot. The name of this robot was Unimate, and it was a hydraulic heavy lifting mechanical arm that could repeat some series of motions. In 1961 it began its first labour, which was withdrawing and stacking red hot metal parts from a die-casting device. Then in the late 1960s and 1970s, an advanced version of the previous robot was developed at the M. I. T. (Massachusetts Institute of Technology) and Stanford University. It was a computer-controlled electric robotic arm using sensors for guidance, which were used with cameras in robotic hand-eye research. It was called P. U. M. A. (Programmable Universal Machine for Assembly). The P. U. M. A. was used to construct automobile subcomponents, such as headlights. Descendants of this robot became used the in 1990s in molecular biology for handling examination tubes and pipetting complicated series of reagents. Apart from robots functional for industrial purposes, other fields of use for robots have started to emerge slowly. According to Moravec (2021), robots that were meant for entertainment started appearing in the 1980s. Then in 1999, the Sony Corporation introduced a famous robot named AIBO, which was a doglike robot that could chase balls thanks to the coloured camera and two dozen of motors for movement of its legs, head and even tail. Technology has improved very much since the era of Unimate and AIBO. Nowadays, the robotic toys, as well as other types of robots, can do much more precise movements and work more effectively

3. The current state of robotics

The current state of robotics has many people arguing over the definition of robotics. For instance, Salichs and Balaguer (2003) imply that there are numerous different verdicts about the current state of robotics. Some people estimate that robotics is a perfected technology, and there is no reason to spend more resources on their further research. Others believe that robotics researchers have been promising things that are quite distant from the real results and are more like science fiction. There is also the third group of people who do not believe in robotics due to the past over-expectation. The authors of this paper assumed that serious revision of the concepts and objectives of robotics is essential. The era where robotic arms and mobile robots were innovative is finishing. There shall begin a new era connected to humanoid robots, autonomous systems, personal and assistive robots, service robots, and many more. This angle points to the consideration that this is really not the post-robotic period but a pre-robotic one. The reason for this argument might be that science fiction literature made robots far better in every aspect as Salichs and Balaguer (2003) later state:

> At the second half of twenty century, the original meaning of the word robotics was changed. While in the science fiction literature a robot was still an artificial machine with capabilities similar or superior to humans, in the real word the term robot was used to refer to much more simple machines. A multipurpose kitchen machine was called a 'kitchen robot'. In the industry, a controlled articulated mechanical system was also called a robot. A mobile robot was an intelligent autonomous vehicle. For many people the term robot has become a general term used for any automatic machine. There have been multiple attempts to redefine the term robot. (p. 2)

It seems that robots across all the fields have different definitions. Salichs and Balaguer (2003) continue that in industrial matter, a robot is defined as an "automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes" (p. 2)

However, in association with web search engines, a robot is defined as an "automated program that follows links to visit web sites on behalf of search engines or directories". (p. 2)

Salichs and Balaguer (2003) ask based on below mentioned definitions whether the famous robot named R2D2 which appeared in several Star Wars movies is actually considered a robot.

The state of the robotics seems that it still has a long way to go until our society gets to droids or robots as can be seen in science fiction literature and movies like “Star Wars”. Nowadays, every artificial machine that helps people in any way can be described as a robot. While many people might say it’s a good thing, scientists opinion states clearly that the term robot should be redefined, which is why they had so many attempts already to redefine it.

3.1 Categories of robots

Every type of robot is unique and has its specific features so it can resolve a specific problem. It seems that almost for every upcoming problem that might occur in the future, there is always a robot which could solve the problem. Therefore, with time there are new types and categories of robots emerging rapidly. In this part, categories of robots which are considered most identifiable with examples will be listed in six categories:

3.1.1 Consumer robots

Consumer or domestic robots are machines that can be bought in order to entertain or help in everyday lives. There are hundreds of types of different consumer robots, from a kitchen robot which helps with making dough to others that help with keeping the household clean or perhaps even robots that help grow plants either inside house or outside in the garden. Possibilities of household usage of robots seem almost limitless as there is the age of the “Internet of things” emerging. One day, a smart home might be a common way of living where every machine is connected to the internet and autonomous in its tasks. Here are three instances of robots that can help with routine assignments.

3.1.1.1 Vacuum and mop robots

This type of robot is very small compared to other vacuuming devices, but it uses docking station which always needs to be plugged in. (See Figure 1). After cleaning, it returns to the

Figure 1. Irobot Roomba i3 – vacuum robot Printed from https://www.therobotreport.com/irobot-roomba-i3-robot-vacuum-emptying-bin/ .

station where it recharges, and some models have a station which collects the garbage that has been vacuumed so that the consumer does not have to clean the robot. Therefore, this one of the first steps in making a robot to be autonomous without needing human intervention.

Asafa (2018) notes this kind of robot is beneficial for saving a lot of time, and companies that make these robots evolve them very often. A decade ago, these robots were brand new innovation.

According to *IRobot* (n.d) some of these robots now have option to mop multiple types of floor and much more precise navigation around the house. Nowadays, these robots are able to map the whole house and can be sent to clean a specific room at any given moment from anywhere through the application on a smartphone.

These robots are primarily advantageous because of the time they save, but they have to be regularly maintained to ensure that their tools do not get damaged. For instance, uncleaned hair stuck on the rotating silicone cylinder can get damaged very easily. In addition, people who use these robots cannot leave their wired headphones and other small, wired goods on the ground because it damages the robot in the same way immediately.

3.1.1.2 Lawn mowing robots

Release of these robots promises future where almost no human maintenance will be necessary. Compared to fossil fuel powered lawn mowing machines, this robot is silent and much smaller (see Figure 2). However, some errors and problems are still to be solved. An issue with sensor, might cause the robot to fail the docking procedure or slight difference in terrain at the point of the docking station might cause it to miss the charging point. This way the battery would drain out, and human intervention would be needed. There is also another important thing when lawn mowing, the machine has to have sharp blades, but the blades become dull as the lawn mower cuts grass and even faster when there are pieces of wood or other objects in the way of its blades, and that is another example where human intervention is needed.

Daniyan et al. (2020) imply that a robotic system combined with A.I. (Artificial Intelligence) can produce a highly efficient grass cutting system with little to no human intervention needed. These robots offer solar charging of their batteries, meaning no fossil fuels are needed.

Figure 2. Lawn moving robot Bosch Indego M+ 700 Printed from https://www.robocleaners.com/en/bosch-indego-m-700-2020.html

As Daniyan et al. (2020) mentioned, the artificial intelligence might be the perfect solution for integrating robots into highly effective machines and not only for grass cutting robots but for all robots and autonomous systems in the future.

3.1.1.3 Façade-cleaning robots

Kouzehgar et al. (2019) explain that despite applying advanced construction technologies to fill the city skylines with glassy structures, maintaining these structures remains a high-risk labour process. Therefore, the utilizing a facade-cleaning robot is inevitable (see Figure 3). On the glass surface of the building, these robots might cause a hazardous situation if they run over a crack in the glass. The issue with this is the navigation on the glass surface. However, the newest simulation shows that the presented solution for them has 90% accuracy of avoiding the cracks in the glass, and therefore the robots might soon be trendy. The trend of these façade-cleaning robots is slowly emerging in smaller versions for common household purposes. It might be the new trend for window cleaning in the future. Once the smaller versions are

Figure 3. Façade maintaining robot Homan Printed from https://autonopia.com/homan/

perfected and equipped with artificial intelligence, these units could become fully autonomous, just like the previously mentioned lawn mowing system. Perhaps, the robot could have sensors which are triggered once the window becomes dirty and then engage cleaning process by itself and afterwards, once the windows are cleaned or when the robot is low on battery or water, the robot docks itself somewhere near the window and refill the water tank and recharge battery.

3.1.2 Drones

Drones could be possibly the most important part of robotics because of their versatility and wide possibility of usage, which is why drones overlap some of the listed categories. Drones can be viewed as consumer robots as they can be equipped with a camera and used, for instance, to see damage on the roof of a building. Drones can also be used in the military. This way, the pilot is remotely controlling the drone from safety without risk. What are drones? Most people

Figure 4. Fleet of futuristic drones Printed from https://medium.com/@jadjamous/3-promising-european-drone-startups-that-are-raising-84682e0608df

view drones as small moving vehicles with no passengers, which can be airborne, on the ground or on water. However, in science articles, drones are mainly referred to as aircrafts. Drones are formally called U. A. V. sometimes also called U. M. A. V. which stands for unmanned aerial vehicle. This term might be more familiar nowadays as the U. A. V. technology is shown by media to be in use in the war conflict between Russia and Ukraine. Abu-Rgheff (2020) suggests that drones provide significant benefits to social and economic spheres as they reduce costs and save time and human resources. Abu-Rgheff (2020) implies that 5G brings excellent potential in terms of linking drones and control air traffic simultaneously, which can have multiple applications in various industries and situations (see Figure 4). Considering that one day, every drone could be controlled by some central artificial intelligence through a 5G network or maybe even faster and more reliable network with lower latency, the air traffic could be as efficient as birds or even bees. There are little to no collisions between most of the

airborne animals as they achieved certain level of evolution. It might be possible to achieve once every drone is interconnected and driven by one entity, while knowing location and direction of movement of each and every other drone. Amazon, being viewed as the largest logistics company in the world could one day be delivering most of its products using drones. Technologies are rapidly evolving, which unfortunately allows people to create a video or a photo of technology which does not really exist yet. While this might be a bad and deceitful act, it can also be a great inspiration for scientists. The perfect example of this is a viral video of a blimp that sent drones in many directions with packages. This would be a dream come true for logistic companies as well as customers. Unfortunately, this video was marked as a fake video, but it is very likely that global leading logistic companies will invest in such technology in not so distant future. Similar actions allow new possibilities for the usage of drones to be discovered. Drones, apart from being a helpful and effective tool for many occasions, are also perceived as a great technology for entertainment. Drones with cameras allow for capturing moments of people from a perspective of a bird. Adding a camera to a drone seems to have made drones a great tool for racing as well. Once drones are combined with a camera and virtual reality tools, the drone can be piloted remotely but viewed from a first-person perspective. This way, racing pilots can achieve acceleration which would never be possible for them with regular aircraft as the drones are lightweight but have powerful motors.

3.1.3 Humanoids

According to Salichs and Balaguer (2003), the creation of a humanoid robot has been the dream of humankind for centuries. One of the first such dreams was in the 1893 novel, where a steam man was driven by a vapour machine. Nonetheless, the age of humanoid robots began in 1973 with the Wabot-1, a robot designed at the University of Waseda in Japan. Japan is a leading country in the development of humanoid robots. Salichs and Balaguer (2003) inform that till 2003, Japanese labs and other institutions have worked on 53% of all humanoid projects in the world. Japan is known widely for implementing humanoid robots in many institutions. According to VICE (2021), in Japan, humanoid robots are already in hotels where they greet guests at the reception and take care of the check-in process, answer questions about the hotel and some other tasks. Sophia, an instance of a humanoid robot can be seen in figure 5. Sophia is possibly

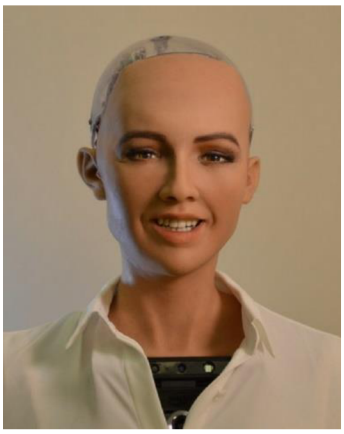

Figure 5. Sophia – humanoid robot Printed from https://www.thinkingheads.com/en/speakers/sophia-the-ai-robot/

the most famous humanoid robot on this planet. This robot was created by a company from Hong Kong called Hanson Robotics. Sophia is using artificial intelligence which is advanced enough to process visual data and has facial recognition, in other words this robot remembers faces of people. The A. I. also allows Sophia to walk, talk and make gestures. Sophia attends various talk shows and conferences where she talks and interacts with people. The Jakarta Post (2017), states that Sophia is the first ever robot that was granted a full citizenship in Saudi Arabia. Sophia has features similar to androids or humanoid robots in the movie called "I, robot". Perhaps one day, humankind will use humanoid robots identically as a replacement for assistants and housemaids.

Kiilavuori et al. (2020) state that due to the rapid advancement in robotics over the past years, social robots are slowly becoming a part of people's everyday lives. These robots (see Figure 5) are increasingly being designed to communicate and cooperate with people and to support people in several humane environments, such as schools, hospitals, and even homes. To guarantee robots integration to human society without any significant problem, we need to understand the reactions of people to robots and other interactions with them.

Kiilavuori et al. (2020) imply that people seem to react and assign human attributes to robots despite robots being artificial. This phenomenon is known as anthropomorphism.

Several studies demonstrate that people may perceive different qualities in humanoid robots based on their appearance and behaviour.

Kiilavuori et al. (2020) experimentally proved that eye contact with a robot could lead to a matching type of automatic affective and attentional responses as eye contact with an actual human. The results of their study showed that even though robots are artificial, humans tend to ascribe mental characteristics to them automatically and thus respond to their direct stare as a socially relevant indication.

3.1.4 Industrial

The International Federation of Robotics (as cited in Jung and Lim 2020, p. 2) define industrial robots as „…automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes … for use in industrial automation applications ".

Jung and Lim state that there is a growing trend in integrating industrial robots to replace human labour. While this trend lowers production costs and almost eliminates labour costs, it raises the unemployment rate broadly. However, in their findings, Jung and Lim imply that even

dough the integration of industrial robots decreases the quantity of employment, it also increases the quality of employment. Jung and Lim expect this trend to continue mostly in countries with a higher ratio of manual labour. Perhaps, the rapid advancement of technology in this field is too great to handle for some regions, as the people in these regions rely on wage from manual work.

3.1.5 Military

Voth (2004) comments that military robots are developing fast and are definitely the future of the military. Robots are made for scouting operations as well as detecting bombs and destroying mines, saving countless lives. There are also robotic medics being developed to provide soldiers with medical aid directly on the field. Although military robots have many advantages, it might be very hard to implement them with A. I. properly. In this particular field, robots are equipped with deadly weapons, meaning that in case of assault, an artificial intelligence might not be able to find a difference between a hostage and an armed enemy. Sharkey (2008) mentions there were serious errors during assassination attempts on heads of al-Qaeda, which ended up in death of civilians. Nevertheless, Sharkey (2008) states that autonomous, artificial intelligence driven robots are in a high position on the United States military agenda.

3.1.5.1. D. O. G. O.

Imram et al. (2019) state that D. O. G. O. is a tactical combat robot (see Figure 6). D. O. G. O. is name for a modern tactical robot developed by Israel's General Robotics. The company presented a new breed of 'combat robots' at Eurostar 2016, intended and designed to assist human combat teams mostly in urban assaults and counterterror operations. The miniature and lightweight robot can climb stairs and move across rugged terrain. These features seem to make this robot perfect for assaults operations in areas which are hard to reach because of narrow corridors.

Figure 6. D.O.G.O. – Scouting
Printed from robothttps://armadainternational.com /2017/10/dogo-ultra-light-hand-held-anti-terror-robot/

3.1.5.2. M. A. A. R. S.

Sharkey (2008) comments that the M. A. A. R. S. (Modular Advanced Armed Robotic System) is a larger heavier robot weighting between 300 - 400 pounds which is about 136 - 181 kilograms. (see Figure 7). The M. A. A. R. S. belongs to the talon family of robots all of which are controlled by one digital control unit. Sharkey (2008) states that the M. A. A. R. S. and other talon family robots can be equipped with heavy machine guns M240 or M249, Barrett.50 calibre assault rifles, 40 mm grenade launchers, or even antitank rocket launchers. Compared to the previously stated D. O. G. O, it is made for heavy assaults while the D. O. G. O is made for urban assaults, where it can overcome stairs and focus on disarming a lighter target.

Figure 7. M. A. A. R. S. robot https://www.forces.net/services/tri-service/maars-mission-military-patrol-robot

3.1.6 Self-driving cars

As Molla (2018) states, a self-driving car, also known as a robot car, autonomous car, or driverless car, is a vehicle that can sense its surroundings and move with small or no human intervention (see Figure 8). Autonomous cars merge information from various sensors to perceive their environments, such as radar, computer, Vision, Lidar, Sonar, GPS, odometry, and inertial measurement units. Advanced control systems interpret the information acquired by sensors to identify appropriate navigation paths as well as obstacles and relevant signage.

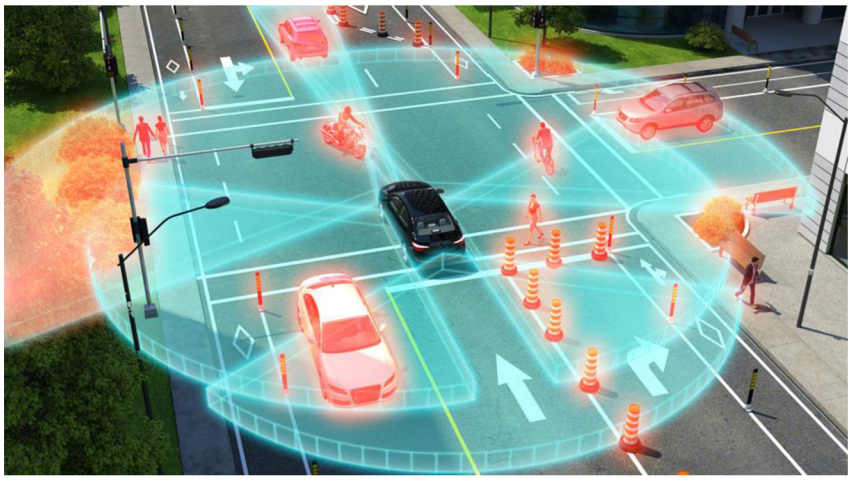

Figure 8. Possible vision of an autonomous car Printed from https://www.ttnews.com/articles/canada-leader-ai-now-taking-aim-driverless-cars

Self-driving cars have six different levels of driving automation. Ondruš et al. (2020) list these levels in their research article. The below mentioned levels taken from the article correspond with the levels that were defined by German Federal Highway Research Institute. The first level of driving automation provides no driving assistance for the driver. Ondruš et al. (2020) define the first level of driving automation as follows:

> Level 0 (No automation): This is where the vast majority of cars and trucks are today. The driver handles steering, throttle, and braking (ST&B) monitoring the surroundings, as well as navigating, and determining when to use turn signals, change lanes, and turn. But there can be some warning systems (blind-spot and collision warnings). (p. 227)

On the second level, the car provides more automation with some systems, but the driver is still expected to be ready to take control of these systems at all times. Ondruš et al. (2020) explain the second level of driving automation as:

> Level 1 (Driver assistance): Vehicles in this level can handle S or T&B, but not in all circumstances, and the driver must be ready to take over those functions if called upon by the vehicle. That means the driver must remain aware of what the car is doing and be ready to step in if needed. (p. 227)

The third level is the last level that holds the driver responsible for the actions of any driving system as it still requires the driver to pay attention to the situation on the road. As Ondruš et al. (2020) state that the third level is:

> Level 2 (Partial assistance): The car handles ST&B, but immediately lets the driver take over if he detects objects and events the car is not responding to. In these first three levels, the driver is responsible for monitoring the surroundings, traffic, weather, and road conditions. (p. 227)

On the fourth level, the car and sequentially the manufacturer of the car become responsible for the actions of the driving assistant or autopilot. Ondruš et al. (2020) describe the fourth level as: “Level 3 (Conditional assistance): The car monitors surroundings and takes care of all ST&B in certain environments, such as freeways. But the driver must be ready to intervene if the car requests it.” (p. 227)

The fifth level provides almost full automation at this point and the driver is needed only occasionally in poor conditions. Ondruš et al. (2020) say the fifth level is:

> Level 4 (High automation): The car handles ST&B and monitoring the surroundings in a wider range of environments, but not all, such as severe weather. The driver switches on the automatic driving only when it is safe to do so. After that, the driver is not required. (p. 228)

Finally, the last sixth level of driving automation provides a full autonomous driving assistant, and the driver becomes a passenger. Ondruš et al. (2020) claim the sixth level of driving automation could be defined as: "Level 5 (Full automation): Driver only has to set the destination and start the car, the car handles all other tasks. The car can drive to any legal destination and make its own decisions on the way. (Standard SAE J3016, 2016)" (p. 228)

According to Ondruš et al. (2020), The levels mentioned above are significant as they provide information about the technological capabilities of a car in terms of automation for the user. The most significant step in these levels occurs on level 3, where the car has the ability to scan the environment.

Molla (2018) further says that benefits include reduced costs, increased safety, increased mobility, increased customer satisfaction and reduced crime. Safety benefits cover a decrease in traffic collisions, consequential injuries and associated costs, including insurance. Automated cars are predicted to improve traffic flow, provide enhanced mobility for children, the elderly and disabled. Free travellers from driving and navigation chores, reduce fuel consumption. It could also significantly decrease crime and the need for parking location, and perhaps even aid business models for transportation as a service, mainly via the sharing economy. Problems combine safety issues, insufficiently developed technology as well as liability and the desire of individuals to control their cars. Legal framework and government regulations can be problematic as well. The most urgent problems are loss of privacy and security concerns, such as hackers or even terrorism. From an economic viewpoint concern

about the resulting decline of driving-related businesses in the road transport industry, and the risk of increased suburbanization as travel becomes more comfortable.

Figure 9. Possible visualization of an autonomous car Printed from https://knaufautomotive.com/the-autonomous-car-when-will-vehicles-no-longer-require-a-driver/

Autonomous cars are the future of personal transport. As previously explained, this concept brings many benefits in many terms and brings some issues, such as security threats and other issues. Security is crucial when speaking about autonomous cars as they can be hacked. Schellekens (2016) states that in 2015, two hackers accomplished hacking a car successfully and took over vital functions such as engines and brakes. This take over was unique because physical access to the car was no longer required. It was done via a mobile telephone network. This act raised many questions, for instance, whether manufacturers of automobiles are taking sufficient countermeasures to eliminate cybersecurity threats. According to Iskander et al. (2019), another issue could be motion sickness. Motion sickness in cars causes nausea, headaches, and possibly disorientation. These symptoms negatively affect the health of passengers undergoing different types of motion. This also includes virtual motion while using VR (Virtual reality) technology. There is no universal solution to this because every passenger has different physiological traits. With autonomous cars, there is a new problem emerging. The problem of car sickness transforms into autonomous car sickness.

Iskander et al. (2019) also claim that:

> To ensure advancement of fully-autonomous vehicles, a comfortable experience must be provided to the passengers. An important factor that affects the acceptance of autonomous cars is the capability of passengers to perform non-driving tasks like reading, relaxing, and/or socialising in a comfortable style with no or limited motion sickness symptoms. (p. 716)

Iskander et al. (2019) explain that drivers who previously never suffered from motion sickness while driving might feel different while riding as passengers in autonomous cars (see Figure 9). This might be caused by the lack of controllability of the car combined with sensory conflicts of the passenger.

According to Smyth et al. (2021) solution to this sickness might already be on its way. In their research, the increase in visuospatial ability was directly responsible for reducing motion sickness by 51% in the simulator and 58% in the on-road trials.

Autonomous cars have many issues to be resolved, but their advantages far outweigh their disadvantages. For instance, Ondruš et al. (2020) claim that a new report predicts a reduction in the number of accidents by 80% by 2040.

4. Predictions for evolution of the future state of robotics

It is nearly impossible to predict the future with so many new information every day. Nevertheless, scientists must try and do their best because the future will not come on its own and humankind has to be ready for what the future may hold. Some of the technologies, which are nowadays already in use have been a science fiction in the past. Science fiction might be a great way to make predictions of the future technologies as it inspired many actual inventions. One of many predictions made by scientists as well as science fiction is the act of technological singularity.

4.1 Technological singularity

The term technological singularity can be best explained graphically (see Figure 10). This Singularity is a particular point in time when the intelligence of machine surpasses the human intellect. The reason for this prediction is that the intelligence of the machine is growing exponentially. In comparison with human intelligence, which is increasing almost linearly, it is clear that machines should become superior to us, but this is just prediction. The reason for this might be that human intelligence is believed to be increasing with evolution. However, machines either learn from us directly or get a detailed description of their purpose. Therefore, robots or machines might get the knowledge that humans achieved through centuries of research in a matter of years. The Singularity does not necessarily mean any danger.

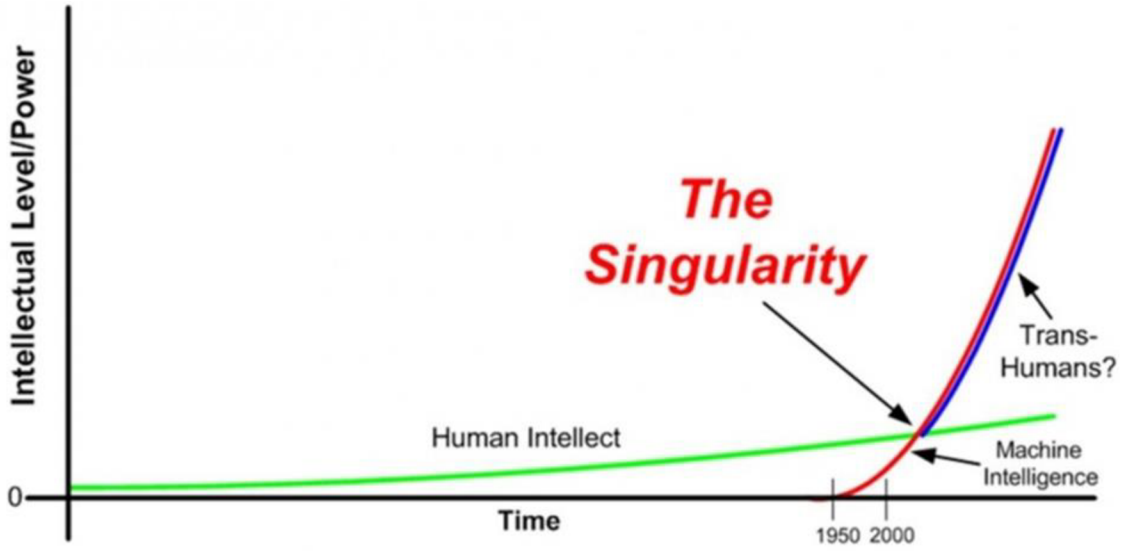

Figure 10. Graphical explanation of technological singularity Printed from https://hpluspedia.org/wiki/File:Singularity-graph.jpg

According to Kurzweil (2005):

> It's a future period during which the pace of technological change will be so rapid, its impact so deep, that human life will be irreversibly transformed. Although neither utopian nor dystopian, this epoch will transform the concepts that we rely on to give meaning to our lives, from our business models to the cycle of human life, including death itself. Understanding the Singularity will alter our perspective on the significance of our past and the ramifications for our future. To truly understand it inherently changes one's view of life in general and one's own particular life. I regard someone who understands the Singularity and who has reflected on its implications for his or her own life as a "singularitarian." (p. 7)

As Kurzweil (2005) later explains, the idea behind the impending Singularity, the rapid pace of change of human-created technology is accelerating and evolving exponentially. Exponential growth may be deceptive because it starts almost imperceptibly and then sets off with unexpected ferocity. However, Goertzel (2007) argues that the scenario which was pointed out by Kurzweil is not the only plausible one, claiming that computer hardware and brain-scanning are more predictable technologies than so-called non-human-brain-based artificial intelligence. However, Goertzel (2007) also later states that Kurzweil took into account point similar to the one pointed out by Goertzel as Kurzweil predicted a brain emulation of A. G. I. (Artificial General Intelligence) on a human level in the year 2029 and then the technological Singularity in 2045.

It is undeniably hard to predict how would the world change in case of an event such as technological Singularity. Robots nowadays have abilities that people in previous centuries would not even dream about, and yet for people of today, these once unimaginable abilities are considered daily tasks. If the same logic is applied to the future, there might be a future that scientists are unable to predict or even think of today.

What is more, people will have to accept the fact that a machine of their creation is more intelligent than its creator. Nevertheless, probably the most critical question remains unanswered, and that is what robots will do after the point of technological Singularity is reached. Will the robots enslave humans or decide that humans are self-destructive species and try to prevent humankind from destroying its environment by stopping specific processes and habits? Scientists can only argue but cannot answer what exactly will happen with absolute certainty.

4.2 Lifespan extension

The human race always sought to extend the time spent in the world. In the past, it was done via medicaments, various herbs, or diet. However, the future of the human race offers many possibilities through technology. People can 3D print new organs or use high-tech prosthetics, as can be seen, for instance, in the upcoming science-fiction game title "Cyberpunk 2077". The world might one day become a lot more effective in case scientists find a way to prolong life or possibly achieve certain immortality. Then, the experts in various fields would not have to fear death and could finish their work and build on their knowledge without the need for students to replace them, which could mean highly skilled personnel across all fields.

There are more ways that humankind considers prolonging the lifespan of humans. Some consider becoming Cyborg and replacing impaired body parts. Others want to upload their mind into a shared cloud. Nowadays, real cyborgs are walking around planet Earth.

4.2.1. Cyborgs

Ramoğlu (2019) explains that the cybernetic organism or cyborg is a term first invented by Clynes and Kline (1960) to define a puzzling human-machine connection. Freshly, augmented human and transhumanism terms have been used in H. C. I. (Human-computer interaction) referring to the same concept. There are numerous definitions of the cyborg from sociological, medical and maker viewpoint.

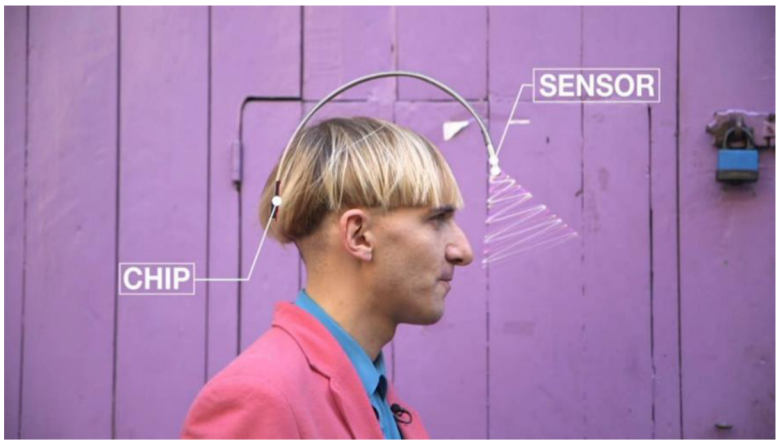

Figure 11. Neil Harbisson – Cyborg activist
Printed from activist
https://www.ripleys.com/weird-news/cyborg/

The first world-famous cyborg is Neil Harbisson, a man who can "hear colours" (see Figure 11). As Ramoğlu (2019) states, Harbisson is a cyborg activist and cyborg himself, which can be seen by an integrated antenna coming right out the back of his head and ending before his forehead. The antenna is a unique microphone scanning for wavelengths, and every wavelength can be heard differently. This way, Harbisson overcame colour blindness, and in addition, the

antenna allows him to see infrared colours, which cannot be seen by the human eye. Harbisson can now be seen in various T. E. D. talks, which stands for "technology, entertainment and design talks", and other technical conferences presenting “cyborgization” as a new way of solving issues with the human body. Many people decided to follow his vision, and these people call themselves cyborg activists. Cyborg activists came with the idea of designing new senses. Ramoğlu (2019) notes that the Cyborg Foundations motto, “Design Yourself”, which is then followed by “We are now free to design how to perceive reality” does emphasize the importance of design in terms of this topic. There are many concepts of new senses, but it is hard to imagine that there could be more than the five basic senses the human race already has. The first artificial sense that is considered to become a new ordinary sense is "the North sense" or a strange sense of vibration when the user turns centre of his body to the north pole.

In matters of cyborg framework and design Ramoğlu (2019) introduces three main ones as follows:

> “Application method (Body implementation, wearable)
>
> Purpose (Improve human body, repair human body)
>
> Scope (Physical ability, mental ability, sense)” (p. 1218)

The application method shows the level of integration of technology to the human body. The device is either wearable or integrated directly into the body. Wearable devices like exoskeletons would improve the walking abilities of users with walking difficulties. Then there are earbuds with the function to translate and provide an understanding of various languages. Integrated devices, on the other hand, are still in the early adopter stage. Nevertheless, these devices are trending. There is a possibility of having R. F. I. D. (radio frequency identifications) or N. F. C. (near field communication) in your body. In case these technologies or similar wireless technologies are adopted on the world market, people could pay for goods through a terminal by using only their arms without the need for a wallet or mobile phone. Body modification can be divided into two types, permanent and temporary. Stated examples were permanent, but tattoos, for instance, are considered as temporary modifications. The most critical problem to be solved is what to do if the device malfunctions. There must be a backup created.

The purpose is a parameter that shows two main conditions, repairing and improving. The repairing category focuses on replacing parts of the human body that malfunctioned or lost the

ability to function with artificial parts such as artificial legs or contact lenses. The improving category includes gadgets. For instance, a pogo stick helps jump higher or thermal goggles improve vision in the dark.

Hogle (as cited by Ramoğlu 2019, p. 1219) observes that "The natural human body definition is based on cultural norms" and Lock and Sinding claim that (as cited by Ramoğlu 2019, p. 1219) "previous studies also indicated that how being 'normal' and 'healthy' has been changed over time." Ramoğlu (2019) reacts "Therefore, technology can help a person to live a 'normal' life like other healthy people."

The evolution of our society will likely change the way mankind views prosthetics and artificial limbs and organs, over few decades. Nowadays, artificial pumps that replace the heart are already being used. Perhaps, every organ in the human body could be replaced by a well-designed artificial organ in the future.

The scope is the last parameter and defines the context of repairing and improving the human body. Ramoğlu (2019) states that the scope of cyborg contains physical abilities (running, jumping), mental abilities (calculating, access to information, language), and senses (vision, hearing).

Ramoğlu (2019) comments that:

> This category does not only contain existing senses but also developing new senses such as feeling earthquakes or hearing colors. Harbisson noted that he learned to hear different sound frequencies as colors over time and he started to hear colors without matching the beep sounds. So, if users exposed to feedback for a long time, they may start to feel that information instead of process it. The Time Sense project by Harbisson was aimed to feel time as a sense by turning the heat sensation around the head according to time. (p. 1221)

These prosthetics are considered a massive step forward for health and life expectancy as these devices could soon help us in everyday lives. Perhaps a human being could be one day modified enough to survive on other planets or in other hostile environments where otherwise life would be impossible.

4.2.2. Digital mind (Transcendence)

Transcendence and digital mind are, for now, highly theoretical terms. But the future looks promising, and scientists might find the right solution to this problem. This theory is attractive as it promises a certain degree of immortality. When compared to our very fragile bodies, the cloud would seem like a longer-lasting solution without the need for serious maintenance.

Cave (2020) explains that:

> Like all immortality strategies, those based on Al must solve the problem of the body. No matter how well we take care of ourselves, how much we strive to stay fit and healthy, our bodies inexorably degenerate and fail. For someone seeking immortality, the body must therefore either be transformed into something that can withstand the rigours of time, or transcended altogether. (p. 311)

Cave (2020) comments that mind uploading or achieving digitalized mind is something that was always sought by humankind as it promises immortality. Cave offers a scenario introduced by Geraci, who followed both Moravec and Kurzweil and suggested two stages of evolution "the Age of Robots" and "the Age of Mind". There are two ways to view this scenario. Cave (2020) explains that the first way is to consider Geraci's suggestion that these two stages will happen sequentially. Mind uploading is also being pursued by neuroscientists directly now, which is said to cause some people to be unwilling to wait until the Age of Robots has finally arrived and became the new reality. The second possibility is that, although it is possible to distinguish "cyborgization" from mind uploading clearly, they can nonetheless also be viewed as a spectrum because, in the future, both can happen simultaneously.

Cave (2020) states that this spectrum ranges from minimally technologically altered human to fully transcended digital avatar independent of a fragile physical body. Between these two ends of the spectrum, many degrees of transmutation can be found. The spectrum shows the progress of "cyborgization", and if humankind walks this path, it could gradually replace every part of human body parts and brain until all the components are inorganic. Once humankind passes that point, the brain will no longer be brain and will be considered fully transcended on a new level of ageless existence.

4.3 Future ordinary gadgets and technologies

Future sometimes seems to be so far, but some technologies emerge suddenly, and some seem too extraordinary to be real, yet many technologies, in the end, become real. In the future, it is likely that humanity will have many gadgets that surpass our current knowledge. One of such gadgets might be the Neuralink.

4.3.1. Neuralink

Stockmeyer (2019) explains that project Neuralink solves the idea of linking the human brain directly to a computer system, which is not a new idea. The first B. C. I. (Brain-Computer Interface) were introduced in 1950s. Stockmeyer (2019) further explains that the inside of the human brain consists of neurons that respond to electrical indications by creating small electromagnetic fields. Therefore, Neuralink could have the ability to translate these fields into data and possibly give the human user a possibility to interact. In order to detect these electromagnetic fields, which are also called action potentials, Neuralink uses small electrodes which are inserted with a neurosurgical robot. Then the collected data is processed in the N1 chip. This new chip is wireless, and therefore, no open hole in the skull is needed, which prevents the human user from potential infection. The nearest milestone is to help people with spinal cord injuries.

Director of company Neuralink predicts that B. C. I. could become the interconnection of symbiosis between a human brain and artificial intelligence in the long term. Nevertheless, the chances are high that Neuralink will make this gadget a consumer product in the future. This would open many possibilities, such as listening to music by thinking about it without any earphones or maybe even using previously uncontrollable processes in the bodies of the human user. However, before Neuralink becomes an ordinary gadget, the company has to overcome certain obstacles in its development. Neuralink uses practices which could be considered controversial as the technology is being tested on monkeys and rats before moving to tests on human beings. Stockmeyer (2019) implies that:

> "Furthermore, the whole concept of linking human brains to computers and possibly creating a 'superintelligence' or an AI bears the question of whether this is ethical. And what about the risks for patients?" (p. 4)

Nonetheless, placement of Neuralink seems less risky than some procedures.

4.3.2. Nanorobots

Nanorobots or nanobots are likely in the scope of scientists who have been involved in robotics, probably since the word robot exists. As the part of their name suggests, these robots would need to be very small robots. They need to be at least tinier than a micrometre to be more precise. As Khawaja (2011) points out the nanotechnology concerns only scales that are so small, that they can be defined as an order of 10^{-7} to 10^{-9} of a meter. In other words, the nanometre scale for these robots ranges from a few nanometres to several hundred nanometres. In case there will be even smaller robots created, they would probably be called pikobots.

Khawaja (2011) compares this range of size to viral particles. On the other hand, Silva (2004) explains that these sizes are in the scale of molecules. For instance, a D. N. A. (Deoxyribonucleic Acid) molecule is about two and a half nanometres long. Another example would be a sodium atom, which is about two-tenths of a nanometre wide. Nanorobots are primarily sought for medical applications as their size would allow them to travel inside our cells and possibly alter human physiology on the cellular level. Silva (2004) explains that devices on such a small level could, in fact, be designed to interact with cells at the subcellular level. Silva (2004) explains that devices on such a small level could, in fact, be designed to interact with cells at the subcellular level. This would allow a certain level of integration between technology and biological system, which would be previously impossible. Silva (2004) also states that nanotechnology is not a single emerging scientific discipline but a combination of more conventional sciences, such as physics, chemistry, and biology. The combination of these sciences can together form collective expertise that is needed to create a new science this complex.

However, one important question raises, and that is how to make technology on such a small level. Silva (2004) suggests that most synthetic assembly approaches to achieving this goal can be categorised as two primary approaches. These are the "top down" approach and the "bottom up" approach. These approaches to synthesise nanoengineered materials can work with precursors in solid, liquid and even gas phases. The “top down” approach starts with macroscopic material, and then smaller parts are added to this material using lasers or other advanced tools. On the other hand, the “bottom up” approach starts by developing and synthesising tailormade molecules that possess the ability to assemble themselves into higher order structures.

As previously mentioned, nanorobots could be used for medical applications. Khawaja (2011) explains that the word "nanomanipulation" could one-day name surgery at the nano level because such surgery would include nanorobots entering the vascular system of the patient, as well as performing a precise and almost non-invasive surgery. This means fast recovery and possibly no scar on the patient's body. Even though these robots would be much more precise than doctors, human surgeons will likely be always near to intervene or control these nanorobots in case of emergency.

5. Conclusion

The goal of this thesis was to present different types of robots, along with the fundamental problems around this topic, list and describe their many forms. Robots are becoming more and more trendy but are still mostly viewed as a relatively new invention. This paper shows that even though the time of robots is already here, there is still much space for improvement.

The first part focused on a brief overview of the history of robots, where their name came from, three laws of robotics, and why these laws should be edited. Various simulations showed that robots should have the three laws either extended or updated. An experiment proved that direct eye contact with a robot can have similar effects on humans as eye contact with other human beings.

The second part named the current state of robotics and showed the categories of robots with examples of their various uses. Many household tasks can be already replaced with the help of a robot. Drones might become the primary solution for delivering packages. Previously mentioned autonomous cars will eliminate emissions in a way many people do not see yet. For instance, time and energy will be saved as the cars will not wait in a row for other cars in front of them to begin the movement. Instead, cars in a row that wait on the same traffic light will begin the movement simultaneously, and small factors such as this one will enhance the flow of traffic to the point that humankind will realize how ineffective the world was before.

The third part focused on the future of robotics and their evolution with the use of artificial intelligence and discussed the question of technological Singularity and lifespan extension. Who knows how effective might the life extension be, considering that experts might not die but instead live for an extended period of time and perfect their findings not limited by their body or ageing? It seems that cyborgs and other types of robots will become ordinary machines integrated into everyday lives of humans. Who knows what else apart from cyborg hearing colours can humankind create? With the pace of the advancement of humankind in technologies, nanorobots will very likely become a reality and resolve most of the medical and technological issues people might have in the future.

To conclude, the future will be a very different place considering all the factors. Once robots become entirely integrated into our society and combine with our needs, the world as we know it today ceases to exist, and a new, completely different will prevail.

Rozšířený abstrakt v češtině

Potenciál robotů je neomezený, se správnou myšlenkou a dostatečnými prostředky, kdokoli může dosáhnout téměř cokoli použitím správného robota. Roboti jsou skvělý nástroj k dosažení cílů, které si lidstvo dříve nedokázalo představit. V dnešní době jsou tyto stroje schopny poskytnout pomocnou ruku v každodenním životě mnoha dříve nemožnými způsoby. Roboti nyní mohou pomáhat s každodenními rutinními pracemi v domácnosti, špehovat cíl, zaútočit na cíl v nepřátelské oblasti pomocí pokročilé vojenské technologie nebo prozkoumávat místa, kam se lidské bytosti nemohou dostat. S pomocí umělé inteligence by se roboti mohli velmi brzy stát natolik sofistikovanými, že by je lidstvo nemuselo být schopno přímo ovládat a vše by se mohlo zautomatizovat. Vzhledem k vlivu takzvaného „Internetu vecí“ by roboti prakticky fungovali, aniž bychom je někdy znovu kontrolovali. Je pravděpodobné, že někdy v budoucnu by si mohli i samy objednat svou vlastní opravu, jak už to dělají některá inteligentní auta. Vývoj těchto strojů jde rychle dopředu a nikdo nemůže s naprostou jistotou říci, jaká budoucnost nás s jejich neustálým vývojem čeká. Mohli by se stát hrozbou nebo nás možná nahradit v práci nebo nás snad i úplně zbavit nutnosti pracovat. Hlavním cílem této práce je představit roboty s jejich základními problémy, hrozbami, které mohou v budoucnosti představovat, a také vyjmenovat a následně popsat jejich typy a použití. V první části této práce bude popsáno, co vlastně slovo robot znamená, tři základní pravidla robotiky, jak roboti přišli ke svému jménu a stručný přehled historie robotů v níž bude uveden a popsán první robot a také prvé robotické hračky. V druhé části bude uveden seznam kategorií robotů podle jejich možného použití, ukáže se také rozmanitost jejich použití a následně budou blíže představeny některé z robotů, které do těchto kategorií patří. Zde budou popsány roboty, jak je robotický vysavač, robotická sekačka trávníku a také robot co se postará o čištění oken. Pak přijde rada na drony mají široké spektrum využití, a proto jsou v této práci taky detailněji popsány. Další kategorie robotu v této práci jsou humanoidi. Tito roboti vypadají lidsky ale jsou to roboti. Mohou reagovat a odpovědět na různé otázky a je pravděpodobné, že budou v budoucnosti vědět dělat mnohem víc. Dále bude uveden potenciální problém s průmyslovými roboty, protože je možné, že z důvodu jejich početné integrace dojde v některých regionech k stráte víc pracovních míst, než je únosné pro dané regiony. Vojenské roboty budou popsány také, konkrétněji se bude porovnávat těžce vyzbrojený robot užívaný na boj s tanky s rychlým robotem co muže skákat a neutralizovat nepřátelé v úzkých prostorách. Poslední kategorií robotu v této práci jsou autonomní auta. Tyto robotická auta budou detailně popsány i s jednotlivými levely schopnosti

autonomního řízení. Třetí část této se bude zabývat budoucností robotiky, jejím vývojem, který by nás v případě dosažení bodu singularity mohl přivést k zániku nebo udělat ze světa úplně jiné místo. Existuje dokonce možnost, že by se délka lidského života mohla prodloužit pomocí pokročilého využití robotiky. Tato možnost by mohla být docílena více způsoby. Jedním z těchto způsobu je nahrání vědomí do počítače což řeší problémy s poškozením těla nebo stárnutím a tím by mohla poskytnout člověku určitou nesmrtelnost. Další možností, jak si prodloužit život by mohla být integrace kyborgů. V podstatě kyborgem se lze stát tím, že člověk zabuduje do svého těla jakoukoliv technologii. Technologie se různí ale jde bud o opravu nebo o vylepšení těla. Při opravě těla se jedná o záměnu vnitřních orgánu nebo přidání různých umělých končetin. Při vylepšení těla jde o přidaní nových smyslu. Jeden z nejznámějších nově vytvořených smyslu je smysl pro orientaci na sever. Člověk si implantuje zařízeni, které vibruje, když člověk směruje na sever. Dále se v práci píše o Neuralinku, což je chip, který se možná jednoho dne voperuje lidem do mozku a pomůže jim překonat různé potíže anebo taky možná se z nej stane v budoucnosti běžný produkt. Nakonec se v této práci píše o nanorobotech. Vytvoření pokročilých nanorobotů bude bez pochyb dalším velmi významným krokem v robotice, protože jejich potenciál je vetší než u jakékoli jiné technologie v robotice. Proč jsou vlastně nanoroboti tak důležití? Jejich skutečný potenciál je v jejich měřítku, protože nanorobot je tak miniaturní, že může vstoupit do našeho těla na subcelulární úrovni a možná taky jednoho měnit naše buňky anebo možná i D. N. A. Na druhou stranu, je pravděpodobné, že ne každý člověk bude tak nadšený z vytvoření tak pokročilé technologie, protože každá technologie může být použita pro pomoc lidstvu, ale může také představovat hrozbu pro bezpečnost lidí, pokud by byla užívána někým, kdo nemá dobré úmysly. Nedávná situace během pandemie ukázala, jak lidé reagují na nově vyvinuté technologie nebo vakcíny. Lidé mají tendenci nedůvěřovat novým vědeckým pokrokům, zvláště pokud k pokroku dochází příliš rychle. Proto se možná ukázalo, že lidstvo ještě není na takový pokrok připraveno. Doufejme, že budoucnost robotiky přinese snadnější integraci nových technologických pokroků. Každá nová technologie se však nakonec ustálila jak v povědomí lidí, tak i ve využití. Mnohé technologie, co během minulých století vypadali jako nemožné jsou dnes úplně běžné a používají se denně. Jednoho dne možná zjistíme jak neefektivní lidstvo bylo.

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