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NEW UNDERSTANDING OF ROBOTICS

Absztrakt/Abstract

A robotika új felfogása a terület három megközelítését jelenti. Az első a szociológiai szempont területén az emberi, a második a műszakilag gazdasági ellenszolgáltatás fejében, mint a rugalmas és intelligens automatizálási eszközt, a harmadik pedig a robot helyét mutatja be a fogyasztásban.
A robotok fejlődése az utóbbi évtizedekben azt mutatja, hogy nem csak a technológia és ezáltal arobotok képessége változott sokat, hanem a robot kérdések megértését és a mesterséges intelligenciát is felül kell vizsgálni. Technológiai fejlesztések a robotok és a számítógépek új alkalmazásai felé vezettek.

The new understanding of the robotics describes three approaches of the robotics. The first is the sociological consideration in the sphere of human; the second is the technically economic consideration as a flexible and intelligent automation instrument; the third is the robotic in the consumer section.
Robot development over the last decades has shown that not only technology and its capability has changed a lot, but also the understanding of robotic issues and the matter of artificial intelligence has to be reconsidered. Technological advancements have led to new applications for robots and computers.

Kulcsszavak/Keywords*: robot, technológia, új elmélet ~ robot, technology, new theory*

INTRODUCTION

The old wish of humans, to own a machine, which takes over all the unpleasant work, is the origin for a lot of imagination, novels and movies but also the basic for new ideas and inventions. Leonardo da Vinci was one of the first inventors who have made detailed plans and subscriptions for a design of a robot [1].

With producing the first machines similar to robot, the doubts of the people grew, at the same time to become replaceable and it before the uncontrollability of the "intelligent" machinery.

The social effects by the insertion of modern technology became visible for the first time during the weaver's revolt about 1844. Here the existence basis of thousands weaver was destroyed with the invention of the mechanical loom, by the price collapse of the woven material.

At the same time a great number of the population profited from falling prices of clothes and woven products.

This phenomenon, that on the one hand technical innovations substitute human and on the other hand creates new advantages by them, runs throughout to the entire history of industrialization.

In the past robots were seen as helpful devices that increase productivity, today they still do this, but many people argue, if jobs are at stake because of robots. Apart from that controlling robots in a save way is in issue that points at security for many people – for instance in military environments. In the first chapter such questions will be considered under the title “Friend or foe: Privileges and disadvantages of robotics”.

The second chapter “Robotics in Common Life“looks at robots that are used in everyday life. In many cases we do not perceive these technologies as robotics, but keeping in mind that a lot of devices and internet services use artificial intelligence in some way, it will be helpful to give several examples for robotic achievements we have been using for a while now and will be using for the upcoming years.

“New fields of robotics”, the third chapter, gives an outlook where robotics is heading to and what developments we can expect in the next years. Will there be humanoid robots as we know them from science fiction stories or do we have to concentrate on today’s robotics and develops it for future applications.

LITERATURE REVIEW

Robotic in the light in the sociological consideration in the sphere of human, the technically economic consideration and in the consumer section gives in literature many papers, books and scientific works from different academic disciplines. Many television and internet broadcast productions focusses on the sociological and the consumer topic.

Under the headline “Friend or foe” the military robotic is a large part of literary work.

In case of military robots, the literature is often orientated to robotized weapon systems, here special the Unmanned Aerial Vehicle (UAV) technology. Dr. habil. Róbert Szabolcsi deals in many scientific congresses [3][4], symposia’s and publications [2] with the subject UAVs. Magazines and associations like [6] FOCUS- Online and [5] “The Bureau of Investigative Journalism” report on the use of UAVs fighting against terrorism.

In his article [11] “Launching a new kind of warfare”, Peter Warren describes the growth of Future Combat Systems (FCS) till 2015.

Martin Ford [7] fears in his publications that the displacement on the job market by robot weakens the purchasing power of the consumer markets [8]. Aaron Saenz [9], senior editor of

“Singularity Hub”, also discuss the thesis from Ford. Marshall Brain[10] in „Robotic Nation” sees also economic risks in using robot technologies.

1942 [12] Isaac Asimov, in “Runaround”, [14] Jordan Pollack in “Ethics for the Robot Age” and [13] “Sigma and Delta scans” deals with sociological items of robotic.

Jo Twist [14] in “BBC News Online” and Jim Pinto [15] in Automation World, describe examples of fully automated applications quite existing today.

In “Benefits of Human-Robot Interaction”, [17] Pericle Salvini, Monica Nicolescu and Hiroshi Ishiguro, report the requirements for robots to work with humans.

Dr. M. Klos [18], expresses in an Interview with RTL- Nachtjournal the future cost targets for service robots.

FRIEND OR FOE?
PRIVILEGES AND DISADVANTAGES OF ROBOTICS

In many cases new technologies result in new products people will use to make life easier or more comfortable. Since robotics and artificial intelligence have been entering our lives for the past decades both of these fields deliver excellent examples for products that are applied to every field of life – at work, in private life or in the military. Superficially, we associate a lot of privileges with such innovations, because they do a lot of works that are too heavy, too dangerous or simply too annoying for human beings. Or these technologies just fulfill certain tasks much faster and better than we do. This helps us to increase productivity and quality. Looking at all the advantages robotics brings to our lives the question arises whether there are major disadvantages. If they exist, we have to consider if the technological benefits are worth living with these disadvantages or if they can be eliminated by further innovations.

Robots “Friend or foe”, is in a global world also a question of the point of view. In the western industrial countries will be the invention of service-robots for cleaning, customer- service or protecting a great effort for the society. In developing countries, where millions of people life from their work in the service sector, it would be a catastrophe if robots enter this field of application.

The same question rises up with the use of military robots. Using robotized weapon systems can safe many lives of soldiers and reduce collateral damages. From 2011 till 2012, the US- Army increases there drones- arsenal from 200 to 7500 units [5]. With the use of Unmanned Aerial Vehicle (UAV) [2][3], the US military follows their strategy to kill their enemies without risk the lives of their own soldiers. Thus [5] "Bureau for Investigative Journalism" registered from 2004 to 2009, 52 drone attacks against terrorists [6]. These weapons are remote controlled from the US-air force base Creech in Nevada and works with a high efficiency.

The “Bureau for Investigative Journalism” claims, that 535 civilians have been credibly reported as killed since Obama is US President three years ago.

[Fig. 1] The MQ-9 called also “Reaper”, counts to the fight drones who are used in Afghanistan and Pakistan. FOCUS online 5.2012

Productivity – industries profit most

In order to recognize advantages and disadvantages of robotics we have to consider the different fields of use. Production certainly is one of the most important sectors for robot devices, because being used to technological progress are very demanding when it comes to affordable and innovative products. Robots help manufacturers not only to produce these goods at high speed and in large numbers, they also ensure to meet the quality users want to have. Thus, companies like Volkswagen or Apple profit from their robots’ productivity and accuracy. Even in these quantities quality today is absolutely repeatable – a fact that is not only noticed by customers but also valued. At this point there seem to be no direct disadvantages for them, but a closer look will reveal other problems.

Since human workers are not able to compete with the performance of machines there is a considerable shift in work life. Today the companies require much more skilled workers, because the simple tasks are done by robots. The consequence for employees is obvious: They have to adapt to this development and acquire the necessary knowledge if they want to keep their jobs. For the next generation of workers the situation is even clearer: If they want to find a decent job they have to work on their education in advance. Thus, competition on the labor market will rise. On the one hand, unskilled workers will have difficulties finding a job, on the other hand companies might have problems to find enough skilled employees as it can be observed in many industrialized countries.

In [7] “Machine Learning: A job killer?” Martin Ford sees another risk in job life. According to his opinion not only hard work will be done by robots, but knowledge-based jobs might be in danger, too:

“… in large organizations there is an enormous amount of data (activities coupled with outcomes) that is waiting for a machine learning algorithm to come along and churn though it. That may ultimately result in software automation applications of unprecedented sophistication. Anyone who sits in a cubicle performing a knowledge-based job may have cause for concern.”

He comes to this conclusion because today everything, from transactions to interactions and e-mails, is recorded. Robots are able to analyze and sort such recorded data which might result in the mentioned algorithms. Martin Ford even goes a step further in his book [8] “The Lights in the Tunnel”. There he *“explores the economic implications of a world which is becoming increasingly automated”*, as [9] Aaron Saenz puts it. Ford thinks that the robot caused job reductions could reduce the mass market purchasing power and endanger global economy.

Similarly [10] Marshall Brain sees the possible risks that robot technologies might bring:

Getting Money form an ATM, buying gas from an automated pump, or the existence of self-service check-out line at groceries. In "Robotic Nation" he sees these common technologies as an iceberg that will eventually change the economy, because they are able to eliminate a lot of jobs.

A less direct consequence of robot technologies and increased productivity is the consumption of valuable resources. Producing large numbers of cars, smartphones, or any other products requires much energy as well as materials. The environmental consequences are well-known. Thus, industries are asked to find solutions. They have to focus on alternative forms of energy as well as develop an understanding for the limited resources. Especially in high-tech sectors the issue rare earth is a good example.

Advantages become standards – robotics in private life

The use of robotics in private life differs a lot from that in production environments. Customers, today, do not buy robots as we know robots from the industry or even from science-fiction films – at least not yet. But the daily live in modern countries is dominated by robot technologies. Dishwashers and other household utensils belong to the more obvious, but there are a lot of devices that are the result of robotics or artificial intelligence. The car's GPS navigates us from A to B, traffic lights are controlled by intelligent computer systems, and in some cases trains travel without any drivers. Even the internet and its many services are based on highly intelligent algorithms. All of these advancements are seen as a standard today, because we have become accustomed to the privileges they offer.

Advantages of robotics in private life almost certainly prevail, because they give us a lot of opportunities: more comfort and new ways of communication, for instance. But, again, there are points that might be seen as a disadvantage. One of these points is the price customers have to pay. Latest products, in particular, are the most expensive, because manufacturers have to calculate these goods consciously. Their development devours a lot of money as does the use of high quality materials. Last but not least, marketing and sales have to be paid as well. These factors sum up to the prices customers have to pay if they wish to buy the latest products. Apart from the costs companies have to keep another aspect in mind: knowledge. This is not necessarily a disadvantage, but developers are challenged to stay ahead with their technological process. Similarly to the production, companies are in need of skilled people that are visionary enough to see what customers want to use next – and they have to able to implement these visions into new developments.

More safety – robots on the battlefield

The military always had to face political conflicts and wars that result from these situations. In the past the power of armed forces was defined by the number of soldiers or tanks. Still, such variables are important, but looking at modern military organization even laymen can see that most advanced technologies have long entered the armies. This was most obvious when CNN in 2001 during the first Gulf War showed camera pictures of tomahawks finding their aims precisely. Nowadays, drones or UAVs [2][3] are the latest instrument to operate behind enemy lines either to scout the territory or to attack strategic aims. These technologies have changed modern warfare a lot – for those who are in possession of the technology as well as for those who are not. The question of privilege and disadvantage will be seen differently here. There are aspects, though, that are valid for both sides.

The most obvious issue in military is that lives are at stake. Both soldiers and civil people are in danger. All of them have to be protected as best as possible. Superficially it sounds paradox, but advanced weapon systems are able to reduce human losses. Of course they are more powerful and can cause more damage, but they their precision also is much better than it has been in the past. The military is able to take out aims without having unwanted losses. The reason is not only the weapon's accuracy, but also modern military intelligence. Satellites and drones spy out very millimeter of a region. These information help soldiers on the field as well as at the operational command centre to get a holistic image of what is going on and to plan their strategy accordingly. Intelligent military machines not only help to attack the enemy; they also are used for rescue operations. Robots disarm bombs; scout the territory or even safe wounded soldiers by dragging them out of the battlefield. Such tasks are elementary if the risk for people in combat situations shall be decreased.

The importance of military robots is shown by plans of the US Department of Defense. In his article [11] "Launching a new kind of warfare" Peter Warren says that by 2015 in the US military *"one third of its fighting strength will be composed of robots, part of a $127bn project known as Future Combat Systems (FCS)"*. This is said to be part of the largest technology project in American history.

Robot laws and rights

In all robotic fields people deal with more or less intelligent machines that have to be controlled appropriately. Malfunctions disturb processes and produce extra costs. However, in the military such malfunctions include the risk that people are killed – no matter on which side. That is why the issue of controlling intelligent systems is particularly important here. Taken to an extreme, we can say that military engineers have to develop intelligent weapons that are able to recognize good and bad. This topic is not as new as it seems, though. [12] Isaac Asimov, formulated the Three Laws of Robotics: In his short story "Runaround" from 1942 these laws say:

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 to 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 Laws.*

Although there have been alterations of these laws or additional laws since then, the point remain the same: It has to be ensured that artificial intelligence does not get out of control. Only if this works perfectly well, people will benefit from the many advantages of robotics. There will always be disadvantages that have to be observed carefully, but if the use of robots and artificial intelligence stays safe, people will rather be glad about technological innovations than fight against them.

The [13] "Sigma and Delta scans" give yet another point of view. In these papers future researchers give an outlook of what might be expected from the robot development. The BBC reports that the paper says, *"a 'monumental shift' could occur if robots develop to the point where they can reproduce, improve themselves or develop artificial intelligence"*. The consequence would be that in 20 to 50 years robots could be granted rights. The report continues:

"If this happened, the report says, the robots would have certain responsibilities such as voting, the obligation to pay taxes, and perhaps serving compulsory military service. Conversely, society would also have a duty of care to their new digital citizens"

Having in mind in what direction robots can develop [14] Jordan Pollack asks several questions in his Wired article "Ethics for the Robot Age". He defines a robot as any device that is

controlled by software. Thus, robots are not intelligent enough to understand Asomov's Laws. That is why he considers whether robots should be humanoid or if the connection between humans and robots should be even closer as it already is.

ROBOTICS IN COMMON LIFE

From the industrial revolution onwards comforts in everyday life have been increasing continuously. First, machines supported work. Later, people were able to use many kinds of technology in private life. Especially the 20th century brought a lot of innovations to households and made life easier in many respects: washers, dryers, dishwashers, and cars. Apart from these more or less mechanical devices, electronic has made much progress, too, which resulted in entertainment electronics, computers, GPS systems, and, finally, the internet.

Robotic aids in many fields of life

In fact, we do not recognize in every device we use a robotic connection, but since most technologies are based on the fundamental mechanical and electronic achievements of the last centuries there is a connection that cannot be denied. The already mentioned household utensils or computers are only a part of what can be seen as robotics. The tendency to even more automation becomes obvious if we see the latest vacuum cleaners. They are able to do their work autonomously, scanning the room with sensors and cleaning the whole ground.

Another field of life where robotics plays a major role is traffic. Cars have been built for many years with automatic gears, later manufacturers implemented electric windows and air conditioning. Today cars consist of many electronic aids and computer systems that support the driver either to make the journey safer or more comfortable. Outside the car it is similar: The whole system of traffic lights is controlled automatically. Sometimes it even considers the amount of traffic. Although there are no automatic cars yet driving passengers around, this topic is not too far away, as it seems. Driverless trains at airports, for example, already carry people from A to B. Speaking of cars, scientists will still have to work on the risks in street traffic, because of unpredictable situation as long as people drive other cars.

Computer technologies have entered modern life very fast. Apart from helpful solutions in everyday life the innovations brought a lot of entertainment opportunities to society. Video recorder could be programmed to record TV shows, computer games gave first impressions of how artificial intelligence will develop, and today the internet with its many services is one huge network that operates, once programmed, in many aspects autonomously.

A large field where robotics helps or supports people in a useful way is the health sector. Today such technologies are used in medical treatments or surgeries, because robotic instruments might work more precise than a surgeon can. Patients, too, profit directly from innovations in robotics and artificial intelligence. Deaf people, for instance, can hear again thanks to cochlear implants, blind people can hope for microchips that enable them to see again and paraplegics will walk again as soon as technological advancements result in devices that control the legs. Amputees already use prosthetics that recognize with the help of microchips the walk of the patient and move the artificial knee accordingly.

Many people want to have service robots that help with everyday tasks. At this point the technology hits certain limits today, but nonetheless engineers work on attractive solutions as an example in Spain shows [15]. A group of robotic researchers are University Jaume I has developed a robot librarian that uses cameras, sensors, and grippers to find and collect a book.

This still is a small example for what is possible with service robots, but the potential is enormous. Engineers have the vision of service robots that assist old and disabled people or even do the housework for us. However, such innovations are more or less visions today, because the development of these robots is at a very early stage and very cost-intensive. The next chapter will give some prospects of how robots might be used in the future and what challenges have to be solved.

NEW FIELDS OF ROBOTICS

Looking at the future of robotics the question arises whether we are facing a development based on robot technologies we already know or if we may expect a whole new world of humanoid robots or androids as we know them from science fiction stories. Scientists will keep working on the latter, but existing robot systems will have better chances to survive and to be developed over the upcoming years. The reason is that people already benefit from these technologies and can estimate what will be possible in the next years. Humanoid robots will also have a chance to be used as service robots, for example, but their development takes much more time and – even more important – the costs for those robots have to be reduced a lot until they are attractive for civil purposes.

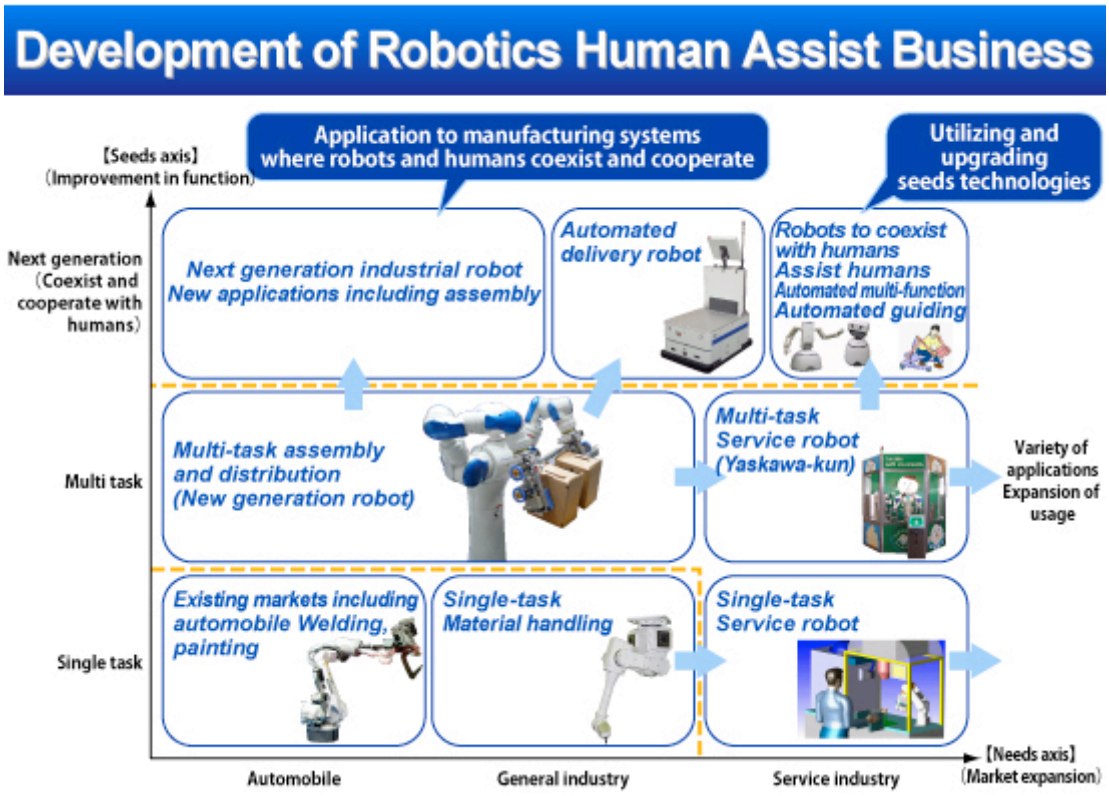
As it was in the past production environments will be affected by new robot technologies at first. Today companies still need people that operate robots, program them and do some working steps within the process chain. In his article "Fully automated factories approach reality" [16]Jim Pinto gives an impression of what the future will look like. He names IBM as an example for having one of the first "lights out" factories. There robots produce keyboards fully automated. Only a few engineers and technicians support the machines and they need people who deliver raw materials to the factory and pick up finished products in the end. Pinto closes his article with an old automation wisecrack: "The fully automated factory of the future employs only one man and a dog. The dog is there to make sure the man doesn't touch anything, and the man is there to feed the dog."

Regarding the fact that the amount of cars will increase the importance of robot technologies and artificial intelligence for traffic solutions and car development will increase as well. First approaches can be seen in today's cars. They analyze the surrounding traffic, assist in steering and break in emergencies when a minimum distance to the car in the front is reached. Some scientists work on solutions for cars that drive completely on their own, which is already possible. However, they have to consider the traffic as a whole, which means that interaction between cars has to be guaranteed in order to avoid crashes.

Coming back to service robots the matter of interaction is an important issue, too. Human-robot interaction (HRI) is an interdisciplinary research field that aims at the improvement of interaction between humans and robots. Thus, service robots in particular are good examples here. The point is that service robots as many robot technologies in the private sector do not work isolated from human beings as industrial robots do. Nor do experts work with these robots. Consequently service robots have to easy to handle and of course save for participating people. In [15] "Benefits of Human-Robot Interaction" Pericle Salvini, Monica Nicolescu, and Hiroshi Ishiguro argue the challenges that have to be overcome in order to make service robots successful products in society:

"Robots […] should be endowed with multimodal perception, cognition, and interaction capabilities that enable them to fuse sensory perception from multiple sensors (such as vision, audition, touch, smell, and others), assimilate these multimodal data in real time, and then respond at the timescale of the interaction."

Robot supplier already has their future develop concepts for Human-robot interaction (HRI).



[Fig.2] Yaskawa robotics strategy for the service industry (from yaskawa.co.jp)

As soon as sensing and perception of robots are good enough to recognize the world as it is, it will be possible to develop service robots for a whole range of applications. These robots still have to be affordable, though. As [16] Dr. Michael Klos form Yaskawa Robots put it on Automatica 2012 in Munich: *"Today we need a whole institute to sponsor the development of a service robot. In five years the price might drop below 100.000 Euro."* That is still a lot of money for a device that has a limited capability of doing simple tasks. Of course, the robots fulfill their tasks in a given environment perfectly well if trained correctly and if everything works they are subservient and undemanding helpers. However, as soon as the tasks get more complex, robots will reach their limits. One robot that does the whole household with all its complex situations is a vision that is hardly possible to realize in the near future.

CONCLUSIONS

The development of future robots will be an important issue for researchers as well as engineers. They have to decide, for which purposes robots are supposed to be used in order to find innovative technological solutions. Right now it seems that humanoid robots, for instance, are an interesting field for researchers who want to experiment according to their visions. A widespread use in public will not be realistic due to limited functionality and costs. In some exceptions people might find interesting applications, but the picture of a society with humanoid robots in every household or in public service is far away.

Robots in a form we already know today, namely technological devices based on artificial intelligence, however, will be developed not only by researchers, but as well by engineers in the industries. Almost every year manufacturers improve their products, give machines better features,

invent completely new devices that people buy for different reasons: entertainment, practical uses, or in non-private sectors such as the military. These devices have a great potential to get better and more affordable in the future.

The new understanding of robotics obviously implies social aspects as well as economic aspects. Robot manufacturers will not develop devices that cannot be sold and they have to produce machines that society demands when people get used to new standards and are interested in innovations. The manufacturers' production itself is based on robotics, too. Thus, intelligent machines will accompany us literally in every field of life – a development that never stops.

This development will go step by step and need their time till somebody change the system of development. If robot program- development becomes public, like programming an APP for a smartphone, the speed of enhancements increases significant.

The probably most important stage of development of the robotics will be that if robots are able to be programmed to themselves and to transform even learnt in robot- programs.

At some point robots will get much more intelligent, though, than they are today. This will be the time, when society and industry will have to consider how to deal with this amount of intelligence, how to control robots that are capable of making important decisions on their own. Today the dangers that result from robotics are relatively small in most cases. In order to keep technology under control, people have to make sure that there always is a button that stops the machine immediately if necessary.

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