

Questions about a new ethics

- ethics of medical robots era

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Why do we need robots? Recent history shows that medical robots proved to be needed...

- by surgeons to allow them to operate less invasively, more precisely and safely, sometimes across great distances,
- by firemen and emergency first responders to go into danger zones where no human rescuers can safely venture to evacuate victims,
- by the elderly and disabled to let them live a fuller life and help in their struggle with solitude and disease.

In these areas medical robots extend the reach of physician's hands and allow for more effective movements in hard to reach and constrained spaces, be it the insides of the human body, the theatre of war or a burning building. Medical professionals can have their actions augmented on both the micro scale - while performing a complex surgery and at the macro scale when operating remotely in danger zones. Medical robotics offers a paradigm shift in the way medical responders works. Similar changes apply to home care, for instance in postoperative care or rehabilitation.

However, it's the medical-social companion robots that will be responsible for the greatest impact on human societies. Social robotics will change both the societal fabric and philosophy. Ethics will have to come up with answers for questions such as what are the rules of human to human interaction where a robot serves and an intermediary (remotely controlled medical robot). The very concept of a robot, when first invented was artistic in its nature, it was a technological replacement of a human. Robots were created on Earth in the image of man and for man.

HEALTHCARE SYSTEMS

Robots are needed by people and by healthcare systems, designed to take care of those people. Even

a back of the napkin calculation reveals that we soon will not be able to address the demands of home care without the help of new technologies. Medical-social robots are the only systems capable of delivering effective remote care (when remotely controlled by a physician) or even autonomous decision making and patient interaction.

In Poland the number of people, who are unable to live independently and require care is estimated to be between 1.6 and 2M (as of 2011). We only have 120,000 physicians and only 80,000 of them are actually practising physicians. This means that a patient-to-physician ration is just 1000:2. The situation of other medical personnel is not much better, we only have 250,000 nurses.

It is estimated that by 2035 over 9.6M people will be above 60 years old. According to Central Statistical Office 27% of our society will be in post-productive age. We will have to turn to robots for help. Robotic assembly lines have saved the mass production of cars and improved the standardisation of products manufacturing while lowering the prices and improving the work efficiency. Isn't that exactly what is needed in healthcare?

Certain changes are already visible. In the recent report by the International Federation of Robotics 2013 it is said that "The total number of professional service robots sold in 2012 rose by a relatively low 2% compared to 2011 to 16,067 units up from 15,776 in 2011. Sales of medical robots increased by 20% compared to 2011 to 1,308 units in 2012, accounting for a share of 8% of the total unit sales of professional service robots. The most important applications are robot assisted surgery and therapy with 1,053 units sold in 2012, 6% more than in 2011. The total value of sales of medical robots increased to US\$ 1,495 million, accounting for 44% of the total sales value of the professional service robots. Medical robots are the most valuable service robots with an average unit price of about US\$ 1.5 million, including accessories and services. In 2012, about 3 million service robots for personal and domestic use were sold, 20% more than in 2011. The value of sales increased to US\$1.2 billion. In 2012, it was estimated

that 1.96 million domestic robots, including all types, were sold.

IFR Projections for the period 2013-2016: About 94,800 new service robots for professional use and about 22 million units of service robots for personal use are to be sold. Sales of robots for elderly and handicap assistance will be about 6,400 units in the period of 2013-2016. This market will increase substantially within the next 20 years."

Which leads to an obvious conclusion - a revolution has already begun.

TASKS FOR TOMORROW

We have to solve the problems of:

- care for the elderly and poor
- equal access to health care regardless of the distance from a specialist
- risk reduction for rescue squads when operating in danger zones, disasters sites, quarantined areas; soldiers on missions during the colonisation of space.

Everything indicates that, this is impossible to achieve without medical robots.

How will people who are looked after by a robot cope with it? How will we build relationships among people when a robot intermediary, capable of independent decision making is present? How will we make decisions and how will robots make theirs?

ETHICS

I believe ethics to be the art of making the right choices so let's take a step back and seek advice of the ancient philosophers. For ages, philosophers have been analysing issues connected with the man-versus-man and man-versus-the world relations in order to help us comprehend the reality and find the correct conduct. Before moving onto the moral and ethical dilemmas connected with advances in medicine, let us look at the terminology and the biographical outline relevant to this field. The choice is subjective – essential in the search for inspiration [1].

The term "ethics" comes from the Greek word *ethikos*, meaning a way of conduct accepted in the society, a conduct according to the legal character (*ethos* character). Today, "ethics" is colloquially understood as "morality", although the Latin word *moralis* denotes more the judgement of the appropriateness of a given action than a person's character. Plato (427-347 BC), a known opponent of democracy, believed that most people live in ignorance, and therefore cannot be expected to make the right decision. Knowledge is a virtue, nobody purposefully chooses the wrong way [1].

Robot, of course also lives in ignorance – but in special situation we can imagine that "its" decisions can help us.

In his *Nicomachean Ethics*, Aristotle (384-322 BC) identified two types of virtues: moral (courage, gen-

erosity, modesty, etc.) and intellectual (wisdom, intelligence, reason). We all have the possibility to develop a virtue, however, only few are successful [1].

What kind of virtues we can find in our robot? Which one is the most important?

Thomas of Aquin (1225-1274) perceived moral problems in the context of the law of nature and God's commandments. A moral life is life "in accordance with reason". All people are equal and for all people there is a close connection between happiness and a righteous conduct (conscience) [1].

We - the people - create robots. They should respect the rights which we will indicate. Should we build robot conscience to serve as decision control?

Immanuel Kant (1724-1804) believed that a man's kindness does not depend on the effects of his actions, since there are too many factors which influence these actions and which we cannot influence. The development of the goodwill is the most important human aim [1].

However, the goodness of the robot will depend solely on the effects of its actions. The purpose of the training will be the best fit to the needs of humans, customised and optimised for specific tasks.

Jeremy Bentham (1748-1832) formulated a concept of utilitarianism according to which, one should be useful and act in a way that would cause the greatest good for the greatest number of people. His principle of utility regards "good" as that which produces more pleasure and less pain. Action consistent with the philosophy of utilitarianism means that it is the results or consequences of a given act that decide on its moral value, and not the reasons or motivation behind that act [1].

Robots will be no more and no less moral than its creators. Should a robot be useful only for its caretaker? How should they make decision regarding other people; sometimes what's for good for an individual contradicts what's good for others.

A.J. Ayer (1910-1988) and CL Stevenson (1908-) created the theory of emotivism. According to this theory, the scientific, empirical method of verification of statements is inefficient in ethics, whilst morality is only connected with our feelings [1].

However, we won't program our own feelings in robots we may program our preferences.

The contemporary British philosopher, Alasdair MacIntyre, in his search of understanding of good and evil delves into history and art, such as: the Homeric virtues (strength, courage, cleverness, friendship), Athens' virtues (courage, friendship, moderation, wisdom), and medieval virtues (bravery, justice, moderation, wisdom, faith, hope and love) [1].

Science fiction offers similar views on robot behaviour. Joseph Fletcher considered moral issues in three ways:

- legalistic (based on unknown commands);
- autonomic (rejecting rigid norms);
- situational (e.g. "love thy neighbour").

His situational ethics suggests that decision making should be based on predicting the consequences of a given act. This, however, is not always possible [1].

Definitely relevant for robots - that decision making should be based on predicting the consequences of a given act.

The use of robotics in the treatment process facilitates remote medical care, consultations and the monitoring of a patient's condition. It is therefore a chance for a greater availability and quality of medical services. Robots are a breakthrough in the infrastructure, the organisation of the operating theatre and in the specialised training of surgeons. But how to evaluate a wrong decision or an action of remote physician? How to divide the responsibility for the mistakes of remote robotic devices? The access to information depends on technical resources, software, etc. Therefore, the final effect is influenced by a number of people – engineers, administrators, economists, etc. as well as fortuitous events [1].

Even lower-level robots, let's call them servant robots need to obey the three laws of robotics formulated in the 1950s by Isaac Asimov in his book entitled: "The Caves of Steel":

- A robot may not intervene in human activities (exception - when the activities may injure a human being).
- A robot must obey any orders given to it by human beings (except where such orders conflict with the First Law).
- A robot must protect its own existence, as long as such protection does not conflict with the First Law or the Second Law.

On principle, the laws of robotics set forth the supremacy of man over robots in every circumstances and, in the case of conflict, the task performed by a "less intelligent" robot should be subordinated to a robot equipped with a more comprehensive system of the assessment of its work environment [2].

As far as medical robots are concerned, their tasks are primarily regarded as intervention into the human condition in rescue operations, surgical procedures or different therapies. Currently, robots are also used for psychological therapy, on the grounds of excellent experience of robotics gained in entertainment functions.

Do humans have any obligations or duties towards mechanical devices? No.

The answer may not be that straightforward however if those mechanical devices determine our capabilities of helping others. The guarantee of safety may mean that there is a need of proper servicing and maintenance of devices, which are used for saving lives.

What if robots starts manufacturing robots? Then we may have to ensure the uninterrupted supply chain of parts. What if by enforcing waste sorting and recycling we will involuntarily introduce "racial segregation" of robots and the need of robot "health (service) care? A fund with spare parts?

Remote patient monitoring, treatment of consultations offer a chance to increase the availability and quality of healthcare. Thanks to the introduction of robotics into the treatment process it is possible the practice "remote" treatments. "Existing telerobotic systems can be classified as two categories: teleprogramming systems or telecontrol systems. In teleprogramming systems, operators rely on the visual information only to instruct robots to execute a motion that has already been programmed offline, and the method is basically an open-loop control. In telecontrol systems operators have direct access to real-time control of the robot at the remote site based on real-time feedback of supermedia information, including images, force, and other information for haptic rendering [4]."

Ethics and our sense morality blindly assumes direct human contact. Our conscience and empathy works differently when faced with abstract terms such as lack of direct correlation between our actions and its effects on a fellow human being [2].

How will we morally and legally assess mistakes made through telemedical systems?

Personal, caregiver robots will be our companions in not too distant future. The elderly and people living alone will be taken care of by robots supervised by designated remote care centres. Specialized expert-systems will make necessary decisions regarding the medical intervention, should one be required. Without a doubt, such system will boast a great efficiency, however, what will the social implications of such isolation be?

After Frankenstein and robots, cyborgs are yet another imaginary creation that is entering reality. I have recently met an eccentric English scientist, Kevin Warwick, who is the first man in the world to have autoimplanted into his forearm the so-called electronic chip enabling the transmission of information from and to the nervous system. By implanting a similar electronic system into his wife, he was able to communicate with her also telemedically. Of course we can imagine freely in this way could the Warwick communicate with the robot. At Reading University, Prof. Warwick's team is currently doing a research with the use of naturally cultivated neurons as brains controlling small mechanical systems. The integration of engineering and biology is a fact. This raises the

question as to the borderline between a biological organism and a technical device.

Where is the beginning of consciousness and intelligence? In my opinion, it is when the question "why" appears between the information from the environment and the actions [1].

ROBOTS AND PEOPLE IN THE ARTS

"Robot" is one of only few words of slavonic origin that gained international adoption in contemporary languages. "Robot" meaning an artificial being, built

in the image of man was first imagined by a Czech writer Karel Čapek in 1920 in his Sci-Fi drama "RUR Rossum's Universal Robots".

To summarize: the robot as an art object is created in the likeness of man to carry out work on its behalf. The robot is the invention popularized long (almost 100 years) before he became (will become) a real object. That's what developers are interested in ethical issues has just: neighborliness with robots or hazards arising from their independence or their misuse by people.

Today Drones spread Christmas gifts or... kill enemies in distant lands. That being said, in 2010 robots manufactured by iRobot corporation named Packbot and Warrior helped to save lives in radioactively contaminated zones after earthquakes in Japan. In the Bay of Mexico Seaglider submersible robot was able to monitor oil leakage levels.

Robots are frequently featured in science fiction movies

- HAL 9000 - the artificial intelligence from 2001 Space Odyssey - is a space ship super computer capable of advanced telemanipulation thanks numerous sub systems onboard
- R2D2 and C3PO were among the most memorable of Star Wars characters
- DATA android is almost indistinguishable from other members of the crew of USS Enterprise of Star Trek
- Terminator T800 pictured by Arnold Schwarzenegger
- WALL-E is among very few examples of robots actively taking care of the Earth.

2001 Space Odyssey brilliantly captures the essence of potential conflict between robots and humans. "HAL 9000 is caught in the film, astronauts David Bowman and Frank Poole consider disconnecting HAL's cognitive circuits when he appears to be mistaken in reporting the presence of a fault in the spacecraft's communications antenna. They attempt to conceal what they are saying, but are unaware that HAL can read their lips. Faced with the prospect of disconnection, HAL decides to kill the astronauts in order to protect and continue its programmed directives.

The novel explains that HAL is unable to resolve a conflict between his general mission to relay information accurately and orders specific to the mission requiring that he withhold from Bowman and Poole the true purpose of the mission. With the crew dead, he reasons, he would not need to lie to them. He fabricates the failure of the AE-35 unit so that their deaths would appear accidental..."

Does this mean that we are ready to have robots around us? Can we trust them more than we trust our human neighbours?

We better be ready. As we can read in "Robot Ethics" by Patrick Lin, Keith Abney and George Bekey.

"The emergence of the robotics industry" observed Bill Gates " is developing in much the same way that the computer business did 30 years ago"

(2007). As a key architect of the computer industry, his prediction has special weight. In a few decades - or sooner, given exponential progress forecasted by Moore's Law (that computing power will double every eighteen months or so) - robots in society will be as ubiquitous as computers are today. Gates believes; and we would be hard pressed to find an expert who disagrees."[5]

CONCLUSIONS

Men are from Mars, women are from Venus and robots from Earth. Robots are the most powerful tools of people. [3]

Medical robotics will play a crucial role in the future of our societies, that role however, is not without a fair share of doubts and controversies. The main difference between a robot and a machine is the robot's possibility of being active in human space, thanks to systems of sensors and analyses provided by the sensors. The most important cultural change will involve the presence of robots in our day-to-day life, i.e. domestic robots, service & social robots [2].

What is important in medical robotics is the fact of a direct contact with patient's body, the direct influence on the life of a person, who is being taken care of by a robot. This brings a set of design challenges and communications challenges. Communication and the possibility of making mistakes pose questions, which need to be analysed on ethical grounds [2].

The vision, where robots could be a partners of an elderly and infirm patients greatly fascinates us. A personal robot should improve the safety and the level of freedom of humans [2].

The world's population recently exceeded 7 billion. We are accompanied by a uncountable number of living organisms and by about a million of increasingly intelligent robots. Medical robotics will play a crucial role in the future of our societies, that role however, is not without a fair share of doubts and controversies [2].

We can influence the evolution of species and the quality of life on Earth. Tomorrow intelligent and self-aware robots become rightful members of the human society.

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