Ethics, robotics and medicine development

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Abstract: The humanity was more and more dissatisfied with its skills, especially because they think that our possibility to see, hear or use our sense has limits. In that context, in the XX century were developed a lot of tools for sustaining the medical care. The application of robots in medicine is a new way of developing medicine and could assure a lot of new facilities for humanity. But, of course, for developing robots with high performance a lot of resources are needed and in that way is a privilege for the rich countries. The paper tries to analyze the ethical implication, not only of using the robots in medicine, but, in the same time, of developing the intelligence robots. In respect to this, we will try to pay attention to the ethical dilemma and, of course to correlate the technical problems with patients' needs and rights, with health care services and hospital facilities.

Key Words: ethics, robots, health

1. Introduction

In this paper we reflect how the ethical problem must be involved in use and development of the robots and why we should reconsider the idea of developing this kind of ethical subjects in the students' curricula.

According to The International Foundation of Robotics Research the goal of this representative association*"is to promote the development of robotics as a scientific field establishing the theoretical foundations and technology basis for its ever expanding applications, with emphasis on its potential role to benefit humans."*

Robots are defined by Encyclopedia Britannica like "*any automatically operated machine that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner. By extension, robotics is the engineering discipline dealing with the design, construction, and operation of robots*"

Professor Lee Dai Gil also tries to find a connection between human and robots, and conclude that "*Human beings may be thought as direct-drive robots where many muscles play a role of direct drive motors. However, contradictory to science fiction, humans are much superior to robots in the structural point of view because the densities of muscles and bones of humans are one order lower than steel or copper, which are the major structural materials for robots and electrical motors.* [6].

Robots are used in our day in a different field, like is show in the next figure.

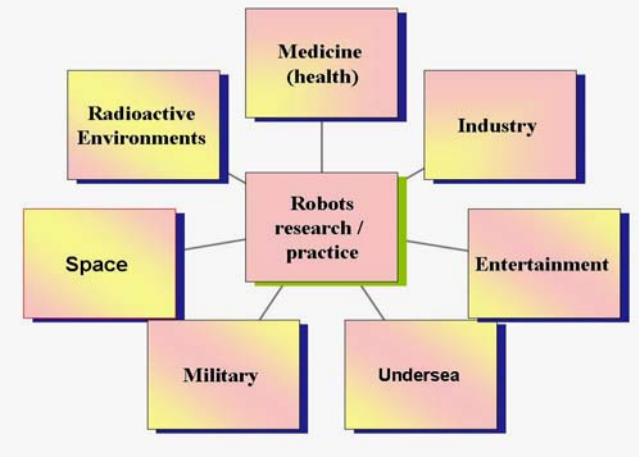

Figure 1.

The first appearing of robots is connected with the personality of Isaac Asimov's science-fiction story Runaround (1942), where a mention also the 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."

Considered one of the best "imagination" of the world Asimov was not the first who described the robots, but we could consider that he is the most impressive mind,

and his great success could be explain by his own words: "*In the 1920's science fiction was becoming a popular art form for the first time ..... and one of the stock plots .... was that of the invention of a robot .... Under the influence of the well-known deeds and ultimate fate of Frankenstein and Rossum, there seemed only one change to be rung on this plot - robots were created and destroyed their creator ... I quickly grew tired of this dull hundred-times-told tale .... Knowledge has its dangers, yes, but is the response to be a retreat from knowledge? .... I began in 1940, to write robot stories of my own - but robot stories of a new variety ..... My robots were machines designed by engineers, not pseudo-men created by blasphemers"* [3]

2. From past to future

Developing the robots it was a dream of the humanity, even from antiquity, when a god could breathe over a figurine and brought it to life, in some countries like: Egypt, Babylon, Sumer or Greece. Some reference points were Mary Shelley's Frankenstein: The Modern Prometheus (1818), the Asimov stories, and the Czech playwright Karel Çapek who in 1918 in R. U. R., which stood for "Rossum's Universal Robots" used the term robots.

Now the robots are really common in few fields, but the future is to have robots for own use. [2, 4] For achieving these goals it is necessary to achieve a high level of autonomy and some properties like in the next figure.

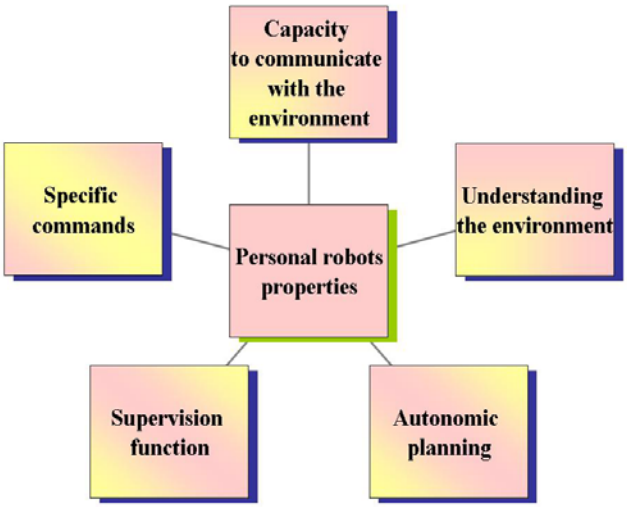

Figure 2.

3. Medical or technical responsibilities

It is clear for us now that, in near future robots will be involved more and more in our life: in homes, offices, in our entire environment.

The main area where the robots could be used are:

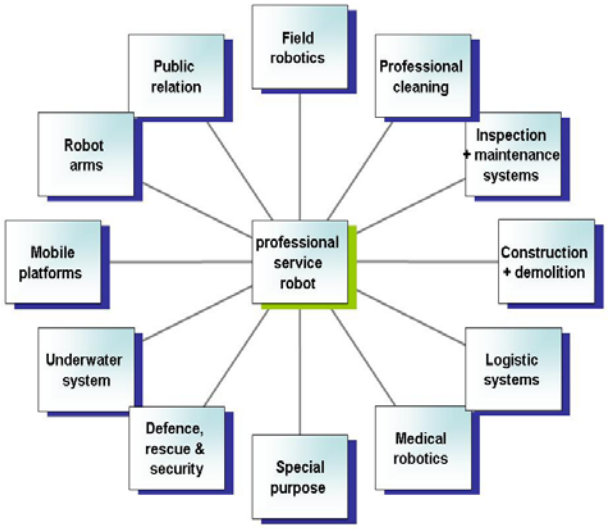

Figure 3.

In respect to that, robots must "learn" and achieve the capabilities to decide. Of course they must use an algorithm and the problems is who have the responsibilities when is right the program, how many details and option could have and what can a robot do when "normal" condition are not assured.

Developing robots capable to do real task for human is not only a dream, is also a reality. [1, 5]

If we compare (using World Robotics 2009 sources) the field where service robots for professional are used it is clear that medicine in not in the top – the most important field where robots are sales are: defense, security. (fig. 4).

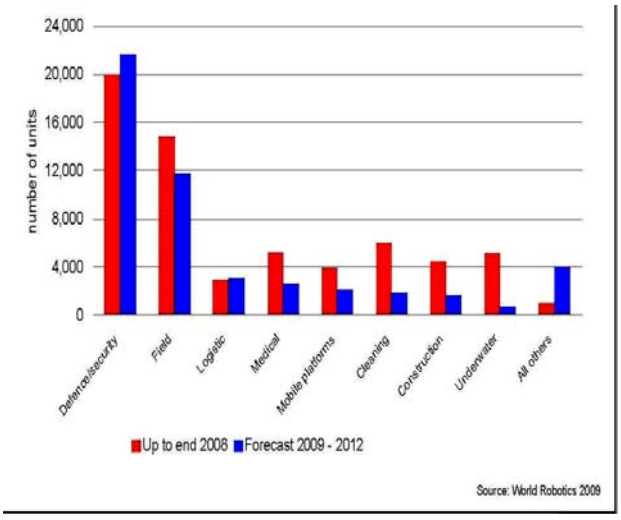

Figure 4.

The medical robots are used especially for: diagnostic systems, assisted surgery or therapy and rehabilitation,

The medical robots used in research are humanoid robot research platform on bipedal locomotion robot and robot arm-and-gripper test beds that allow research on manipulating real objects.

Design criteria for developing a robot are according with their scope and operational criteria and must assure the following characteristics of the entire system: human safety, robustness and payload.

But design and technical development are not enough, even if *"One of the most ambitious aims of Robotics is to design an autonomous robot that could reach - and even surpass -human intelligence and performance in partially unknown, changing, and unpredictable environments."* [15]

It is very clear that medicine, and medical doctor must be involved in that development for assure a high performance of robots in an ethical way.

4. Ethics in robotics used in medicine– an interdisciplinary field

We knew now that ethics in robotics are border areas develop according to the intrinsic ethical dimension of the robots. More and more robots are used in services and it's well accepted that are 8 fields where the robots could be used: medicine, rehabilitation, construction; public relations, environment, agriculture; trade, transportation; hotels and restaurants; safety and security, radiation protection and disaster; households, hobby and leisure. [11, 12]

Using the robots and automation in this fields have a lot of advantages and disadvantages, like in figure 5.

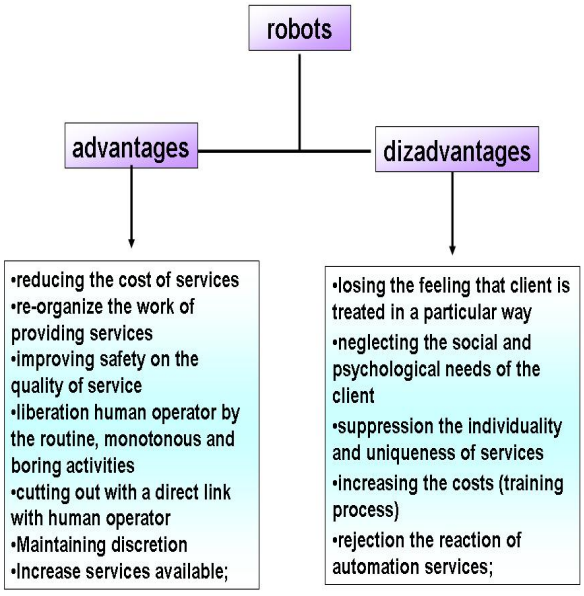

Figure 5

But the most important ethical challenge of using robots is related to the new idea that robots are a new species, "with their rational mind and unshaken morality" [14]

The field involved in medical robots bioethics are:

Figure 6.

As it could be seen in figure 6, robots could be analysed using tools coming from engineering, IT, sociology, law, philosophy or medicine.

The robots could increase the quality of life and human performance and in our world with more and more patients with disabilities, who needs continuum care using robots could be one of the ways of reducing the expenditure in health. In that context increasing the role of bioinformatics and electronic evidence and developing new concept of e-Health and evidence based medicine are connected with the development of robots, and with the necessity to assure the privacy, accuracy, intellectual property and access. [10, 13]

Ethics about robots in medicine put robots in medicine in antagonist, but, in the same way complementary connection with medicine; more and more robots underwent a process of anthropomorphization and humanization and they could provide technological addiction and have an environmental impact of technology.

Could robots have consciousness, self-consciousness, sense of dignity, emotions? It could be any sign of danger that the robots could became our slaves? Is there any reason to consider that we need a special ethical code for assuring the dignity or the rights of robots?

What are the other possible dilemmas?

Robots could assist humans to increase their performance and for the old people could be the opportunity to enable people to continue to lead an active and productive life.

Ethical multidisciplinary approach is available also for

tele-robots and autonomous robots.

The surgical tele-robots could be not only an extended of human reach but also, a vital link between a surgeon's hands and a patient's health.

The ethical analysis of tele-robots is somewhat similar to that of any technical system where the moral praise or blame is to be born by the designers, programmers, and users of the technology. Since humans are involved in all the major decisions that the machine makes, they also provide the moral reasoning for the machine for assure not only the replacement of human but also resolve the psychological problems and assure the safety, security and privacy.

5. Ethics and robots – an educational approach

Developing the knowledge in robotic and automation is not only a opportunity for students, the start must be done in middle school, including by using the internet and data-bases special created for them. [7, 9

The curriculum must be design based by thematic, competencies and level of knowledge. The competencies achieve after that are connected with practice – labour market, work-places, but also with scientific research or to develop adult education. [8]

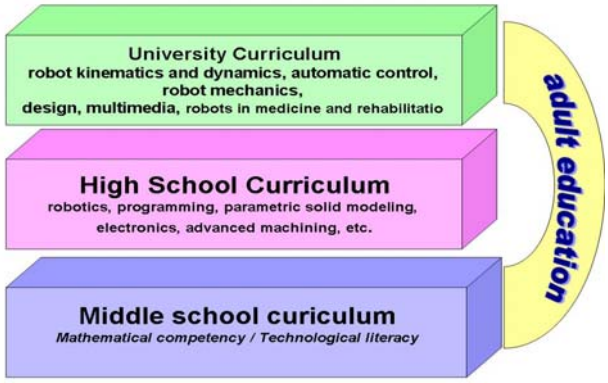

Figure 7.

There is a number of ethical issues which must be present in the robo-ethics curriculum design for university studies:

- dehumanization
- developing the experiment in the medical field without respect all the ethical rules
- modify the communication
- dual-use of technology – developed for military purpose and used in medicine
- human equality
- improving healthy humans
- ethics and extension of the human life, etc

The ethical issue will be very important and well explore in future, and of course is the duty of specialist in ethics to think about this and to try to start discussion between specialists from different field and to develop a guidelines from this field.

8. Conclusion

Robo-Ethics is not only a theoretical way to do what is right or to analyze in different aspect of developing and using robots in medicine. Are the robots our surround environment? Could the robots become our neighbors and friends? The robo-ethics must be involve in developing the products, especially in medicine and to become part of university curriculum, even if the ethical problems are not so different that the dilemma in other bio-engineering fields.

Robots could help doctors to improve the quality of medical services, to do a better diagnosis and to find a modern an efficient way to treat few diseases.

Ethical issue does not seem to be an obstacle for using robots in medicine, maybe also because the development of the filed is not very high, the used of the robots are not included in the health insurance package, and, in that context is not very accessible for more people.

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References:

[1]. Baritz M., Cotoros D. - Human gait analyzed by complex and interconnected system; 7th WSEAS International Conference on Applied Computer Science, Venice, Italy, November 21-23, 2007

[2]. Baritz M., Cotoros D., Moraru O. - Virtual and Augmented Reality Used to Simulate the Mechanical Device, Annals of DAAAM for 2007 & Proceedings of the 18th International DAAAM Symposium, Vienna, Austria, 2007;

[3]. Clarke R. - Asimov's Laws of Robotics - Implications for Information Technology. Australian National University, IEEE Computer 26, 12 (December 1993) pp.53-6

[4]. Cristea L. - The Improvement of Performances in Automatic Dimensional Inspection for Bearing Production, an Important Way to Quality Assurance in Mechanical Engineering, Proceedings of the 8th international conference on instrumentation, measurement, circuits and systems (IMCAS 09). Hangzhou, China: WSEAS, 2009. ISSN 1790-5117, ISBN 978-960-474-076-5, p91-95.

[5]. Cristea L., Baritz M., Cotoros D, Repanovici A. - Aspects of quality assurance in medical devices production, Proceedings of the 8th conference on Signal processing, computational geometry and artificial vision, Rhodes, Greece

Pg: 131-135, 2008, ISBN ~ ISSN:1790-5109 , 978-960-6766-95-4

[6]. Lee Dai Gil - Axiomatic Design and Fabrication of Composite Structures, Oxford University Press. 10-22, 2005.

[7]. Moisil I., Pah I., Barbat B., Popa E. M. - Socio-cultural modelling of the student as the main actor of a virtual learning environment Proc. of the 8th WSEAS Int. Conf. on Mathematical Methods and Computational Techniques in Electrical Engineering, Bucharest, October 16-17, 2006, 119-123, ISSN: 1790-5117, ISBN: 960-8457-54-8

[8]. Pirinen R. - Thematic Curriculum, pg 61-66, Proceedings of the 8th WSEAS International Conference on Education and Educational Technology, University of Genova, Genova, Italy, October 17-19, 200ISBN: 978-960-474-128-1, ISSN: 1790-5109, pg. 61-66, 9

[9]. Repanovici A. - Strategic and Collaborative Approach in Information Literacy Applied in Engineering Teaching. WSEAS Transactions on Information Science & Applications, 6, Issue 3 (March 2009), Pages: 341-351, ISSN:1790-0832

[10]. Repanovici A., - Strategic and collaborative approach in information literacy applied in engineering teaching, WSEAS Transactions on Information Science and Applications archive vol. 6, Issue 3, March 2009, pg: 341-351, 2009, ISSN:1790-0832

[11]. Rogozea L. - Towards ethical aspects on artificial intelligence, Conference Information: 8th WSEAS International Conference on Artificial Intelligence, Knowledge Engineering and Data Bases, Date: Feb 21-23, 2009 Cambridge England, Source: Proceedings of the 8th WSEAS International Conference on Artificial Intelligence, Knowledge Engineering and Data Bases, pg: 507-512, 2009, ISBN: 978-960-474-060-4

[12]. Rogozea L.; Sechel G; Fleancu A - Ethical Aspects in Bioengineering Research, Conference Information: 8th WSEAS International Conference on Instrumentation, Measurement, Circuits and Systems, May 20-22, 2009 China Jiliang Univ Hangzhou Peoples R China, Source: Proceedings of the 8th WSEAS International Conference on Instrumentation, Measurement, Circuits and Systems, pg: 139-143, 2009, ISBN: 978-960-474-079-6, ISSN: 1790-5117

[13]. Simovic V. - The Strategic Role of New Education Technologies With Relation To Usage of ICT Supported Knowledge Management Models for Competitiveness and Performance Management Improvement, Proceedings of the 8th WSEAS International Conference on Education and Educational Technology, University of Genova, Genova, Italy, October 17-19, 200ISBN: 978-960-474-128-1, ISSN: 1790-5109, pg. 44-51,

[14]. Veruggio G., Operto F.: Roboethics: a Bottom-up Interdisciplinary Discourse in the Field of Applied Ethics in Robotics, International Review of Information Ethics, Vol. 6 (12/2006), pg. 3-8

[15]. Veruggio G., The EURON Roboethics Roadmap, Humanoid Robots, 2006 6th IEEE-RAS International Conference on Volume, Issue, 4-6 Dec. 2006 Page(s):612 – 617

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