Towards Industrial Robots with Human Like Moral Responsibilities

Baran Çürüklü, Gordana Dodig-Crnkovic, Batu Akan
School of Innovation, Design and Engineering
Mälardalen University
Västerås, Sweden
{baran.curuklu, gordana.dodig-crnkovic, batu.akan}@mdh.se

***Abstract*—Robots do not have any capability of taking moral responsibility. At the same time industrial robotics is entering a new era with "intelligent" robots sharing workbench with humans. Teams consisting of humans and industrial robots are no longer science fiction. The biggest worry in this scenario is the fear of humans losing control and robots running amok. We believe that the current way of implementing safety measures have shortcomings, and cannot address challenges related to close collaboration between humans and robots. We propose that "intelligent" industrial robots of the future should have moral responsibilities towards their human colleagues. We also propose that implementation of moral responsibility is radically different from standard safety measures.**

Human-robot interaction; industrial robots; ethics; moral responsibilities; safety;

I. INTRODUCTION

A. Industrial robotics is about to enter a new era

In a near future, robots are going to share workbench with humans, they even will work on the same piece together with them. Thus, the role of industrial robots is changing; from being a tool used in manufacturing, to a colleague that engineers and technicians can interact with. This is a different form of collaboration that goes beyond today's human-robot interaction. As a result, next generation industrial robots need to be designed in a fundamentally different way. Furthermore, we need to address challenges with respect to safety from a new perspective. Physical obstacles in various forms such as padding on the robot, high fences (passive safety), or sensors for human detection (active safety), are of no use (Fig. 1). In the near future, we need robots that are aware of their environments and act similar to their fellow human colleagues, thus have moral responsibilities.

This change in the mindset in industrial robotics is due to a number of trends. Firstly, industrial robots are precision instruments that are costly to develop and manufacture. At the same time they are considered to be low production products. On top of this we have reach a situation in which it is getting harder to distinguish robots from different manufacturers. They all look the same; they all perform the same. Thus, increased competition among robot manufacturers forces the industry to design radically new products. Secondly, until now the automobile industry has been the main market of the industrial

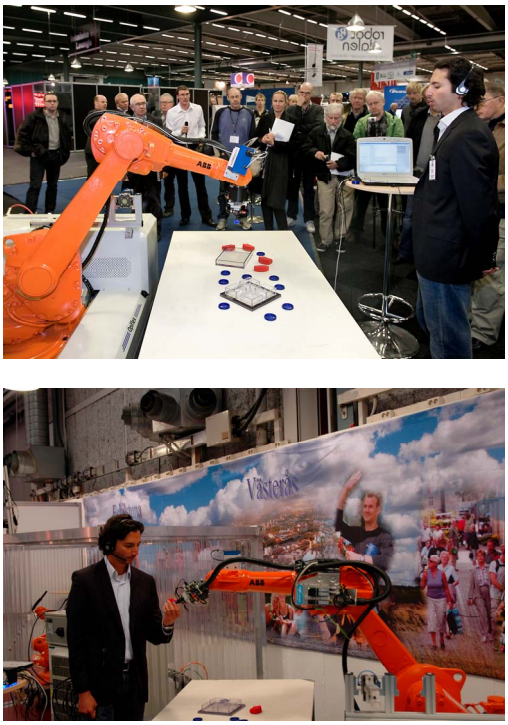

Figure 1. Collaboration between a human and an industrial robot challenges current safety norms. Pictures are from 2009 Scandinavial Technical Fair (top picture is by Peter Nerell).

robots, with welding as the dominant task for a robot. Increased competitiveness in this business area is forcing robot manufacturers to find other customer groups. Many of these new potential customers, we refer to them as Small and Medium Enterprises (SME), are in need of other types of robots than those found in an automobile plant. Usually SMEs do not have expert robot programmers. They also consider industrial robots as being too advanced, and expensive to purchase, maintain and reprogram for a new task. Lastly, technological advancement especially in sensors, electronics, and computers systems makes it possible to design radically different industrial robots. This should not come as a surprise. Today there are a number of highly advanced entertainment robots that are able to interact with humans. It is only a matter

This project is funded by Robotdalen, VINNOVA, Sparbanksstiftelsen Nya, EU – European Regional Development Fund.

of time before there are industrial robots with capabilities as advanced as in their commercial counterparts. In this text we refer to them as intelligent industrial robots (IIR).

B. *Intelligent industrial robots and their putative moral responsibilities*

Today robots do not have any capability of taking moral responsibility. However, IIRs with various degree of autonomy are being developed [1,2], resulting in a new division of tasks between humans and robots. The biggest worry about an IIR is the fear of humans losing control and robots running amok. In [3] we have stated that for all practical purposes, moral responsibility in intelligent agents is best handled as a regulatory mechanism, with the aim to assure desirable behavior. We simply expect a morally responsible intelligent agent, such as an IIR, to behave in a way that is traditionally thought to require human moral responsibility.

Conventional arguments against robot responsibility stem from a view in which agents are seen primarily as isolated entities. In [4,5] on the other hand suggest that we should understand moral responsibility not as individual duty, but as a role defined by pragmatic norms of a group. In this functionalist view moral responsibility can be seen as a social regulatory mechanism aiming at enhancing actions considered being good, and simultaneously minimizing what is considered to be bad.

In order to be able to address the question of moral responsibility attribution to intelligent agents we adopt functionalism/pragmatism and see them as parts of larger socio-technological systems with distributed responsibilities, where responsibility of a moral agent is a matter of degree. Delegating a task to a machine implies its responsibility for its safe and successful completion. If a machine takes care of certain task intelligently, learns from experience and makes autonomous decisions it gives us good reasons to talk about a machine as being "responsible" for a task in the same way that we talk about a machine being "intelligent". Likewise, the responsibility for a task with moral consequences could be seen as moral responsibility. Moral responsibility as a regulative mechanism shall not only locate the blame but more importantly assure future appropriate behavior of the system.

II. EARLY RESULTS AND DISCUSSION

The industrial robot system developed by our group allows a two way communication based on speech, text instructions and vision. The goal is to have a system that, when needed or desired, can take charge and give instructions to users. Thus, industrial robots that are involved in planning of a task have to be aware of the humans' limitations in addition to other constrains. For the system collaboration involves dividing the task between all participants in an efficient and sound way so that the health of the human participants is not jeopardized. Such a system is useful for training novice users as well as testing alternative manufacturing procedures.

Initial tests conducted with the system have forced us to think about safety from a different perspective. It is apparent that exiting methods for safety are not applicable for a setting that concerns a close collaboration between humans and robots as seen in Figure. 1. The situation is likely to become even more complicated in the future when several humans and/or industrial robots are collaborating for solving a specific task. In such an interaction one has to rely on each other. All involved agents need to act with their moral responsibilities in mind, both in the case of one-to-one human-robot collaboration and in more complex settings. Note that this is not different from a group work that solely involves humans.

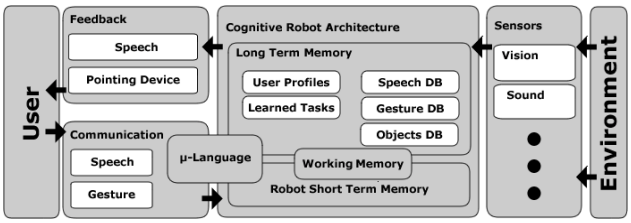

Figure 2. Current cognitive robot architecture.

In the current robot architecture safety measures are found in the so called Long term memory section (Fig. 2). These measures are fractions of program codes embedded into the rest of the program. The next phase of the project is dedicated to investigate how moral responsibilities can be implemented in an efficient way. Robot's moral responsibilities are rules that have the intention of being beneficial to humans in short as well as long term. It is, thus, not straightforward to implement them in as in the case with the safety rules. The continuation of this project will address this issue and hopefully give insights into how industrial robots for human-robot collaboration can be designed.

REFERENCES

[1] B. Akan, B. Çürüklü, G. Spampinato, L. Asplund, "Object Selection using a Spatial Language for Flexible Assembly", 14th IEEE International Conference on Emerging Technologies and Factory Automation, pp. 1–6, September 2009.

[2] B. Akan, B. Çürüklü, L. Asplund, "Interacting with industrial robots through a multi-modal language and sensory systems", 39th International Symposium on Robotics, pp. 66–69, October 2008.

[3] G. Dodig-Crnkovic, "Sharing Moral Responsibility with Robots: A Pragmatic Approach", Frontiers in Artificial Intelligence and Applications. Tenth Scandinavian Conference on Artificial Intelligence SCAI 2008, IOS Press, ISBN: 978-1-58603-867-0, Stockholm, Editor(s): A. Holst, P. Kreuger and P. Funk, May, 2008.

[4] D. C. Dennett, Mechanism and Responsibility, in Essays on Freedom of Action, T. Honderich (ed), Routledge & Keegan Paul, Boston, 1973.

[5] P. F. Strawson, Freedom and Resentment, in Freedom and Resentment and Other Essays, Methuen, 1974.