Reflections on the Development and the Design of Medical and Care Robots

Oliver Bendel
School of Business FHNW
Bahnhofstrasse 6
CH-5210 Windisch
oliver.bendel@fhnw.ch

ABSTRACT

There is a fundamental transformation in the field of health care: operation robots, therapy robots, care robots and sex robots, which can be characterized as medical and care robots (MCR), become more and more indispensable. Surgical robots are similar to industrial robots. Therapy, care and sex robots, however, often have a body and a locomotor system, and frequently resemble animals or human beings. Consequently, some of them can not only perform actions, but have a certain appearance, they can understand the human language and even write or talk, respectively utter sounds. Accordingly, the morality of these machines consists in their actions, in their appearance (including gestures and facial expression), and in their (natural) language skills. This contribution is committed to the findings of machine ethics and raises some thoughts for the development and design of moral MCR, with a focus on actions and appearance, as well as on the (natural) language skills. Using the literature and own research and considerations, appropriate meta-rules are being established, and central problem areas are identified without making concrete technical and design specifications. The problem descriptions allow robotics experts, computer scientists and designers to take into account social and moral aspects and to improve the MCR from an ethical perspective.

INTRODUCTION

There is an increasing use of machines such as agents, chat bots, algorithmic trading computers, robots of different stripes, unmanned aerial vehicles and self-driving cars. They populate the modern world like legendary figures and artificial creatures in Greek mythology, like Pandora, Talos and the tripods, made by Hephaistos himself – with the main difference that they are real in the narrow sense of the word. Some are partially autonomous (acting under human command) while others are completely autonomous within their area of action [8].

"Normal" ethics deals with the morality of human beings. In literature, there are some contributions on the relationship between robotics in health care and (applied) ethics, especially technology ethics, information ethics and medical ethics [10]. Considerations about medical and care robots from the perspective of robot ethics or machine ethics are rather rare [4, 15, 17].[1] The latter discipline pays – as does partly the former one – attention to the morality of machines [1]. Not all technical systems can possess morality, and, of course, one could ask whether technical systems can possess morality at all. Without any doubt, some decisions and actions of machines have moral implications. This is especially true for autonomous, intelligent machines that are able to generate morality in this sense and which can be understood as moral machines [16]. Machine ethics can be seen as a part of information ethics (which includes computer ethics, net ethics and new media ethics) as well as technology ethics. From this point of view, it is only another field of applied ethics. But with good reason, it can also be understood as a counterpart of human ethics [8]. From this perspective, machine ethics presents a new form of ethics.

This contribution raises some thoughts for the development and design of moral robots in the health sector, with a focus on actions and appearance, as well as on the (natural) language skills. The aim is to improve the MCR from an ethical perspective and to support the transformation in the field of health care in this way. Using the literature and the author's own research and considerations, appropriate meta-rules are being established (how should the robot basically be?), and central problem areas are identified (what should it never do?) without making concrete technical and design specifications.

Oliver Bendel was born in 1968 in Ulm. After completing his degree in philosophy and German philology (M.A.) as well as in information science (diploma in information science) at the University of Constance, and after his first professional experiences he did his doctorate in information systems at the University of St. Gallen (Dr. oec.). Bendel has been working in Germany and in Switzerland as a project manager for new media and as a supervisor of the engineering and science departments of several universities. Today he is working as professor of information systems and ethics at the School of Business, University of Applied Sciences Northwestern Switzerland FHNW in Brugg-Windisch.

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[1] Robot ethics deals with the moral implications of the usage of robots (like information and technical ethics) and with the morality of robots (like machine ethics).

ROBOTS IN THE FIELD OF HEALTH CARE

Robots have become more and more indispensable in the field of health care. There are operation robots, therapy robots, care robots and sex robots. All together can be characterized as medical and care robots (MCR). Obviously, the different areas of application overlap, because surgery can be a form of therapy, and in many cases there is no clear distinction between treatment and care. In addition, therapy robots and care robots are often nothing more than specialized service robots. The inclusion of the sex robot in this series will not convince everybody, and yet an appropriate sexual behavior adapted to the individual needs contributes to human health and well-being [11, 6].[2]

Surgical robots perform actions during surgery. They are able to make small and precise cuts, mill precisely and even drill. Therapy robots support therapeutic measures or even independently apply them; they make exercises with paraplegics and entertain people with dementia, challenging them with questions and games. Care robots are able to support or even replace human caregivers; they bring those in need of care the necessary medicines and food, and help them lie down and sit up. Sex robots are available, depending on budgets and taste, as a handy toy or in life-size. They contribute to the pleasure of humans by stimulation or by being penetrated by them [4].

Surgical robots are similar to industrial robots. Therapy, care and sex robots, however, often have a (part of a) body and a locomotor system, and often resemble animals or human beings.[3] Consequently, some of them can not only perform actions, but also have a certain appearance, as well as gestures and facial expression; they can understand the human language and even write or talk, respectively utter sounds. Accordingly, the morality of these machines consists in their actions, in their appearance (including gestures and facial expression), and in their (natural) language skills. The development and design of medical and care robots can be described within the range of machine ethics.

This contribution, as already mentioned, reflects on the development and design of moral MCR. Some areas – as do the meta-rules – equally concern surgery, therapy, care and sex robots (and perhaps other types of robots), others concern only certain types. In order to clearly indicate the scope of the problem, the individual points are being negatively formulated, in the form of questions, in order to make the developers and designers feel responsible. A moral MCR would be the one to which the individual points do not apply, but it should certainly be considered that these points would have to be discussed and negotiated.

META-RULES FOR BOTS AND ROBOTS

In recent years, several recommendations and frameworks in the context of human-robot interaction have been developed, e.g. for the design of personal service robots [14]. The design of MCR was not in the focus of research. In machine ethics, while general philosophical and technical considerations are in a clear majority [1], specializations have just risen to the surface, even in the fields of health care [15]. With respect to the design of MCR from the perspective of machine ethics, there is a big gap to fill. Robot ethics in a narrower sense can contribute as well [17].

In the context of a practical project at the School of Business, University of Applied Sciences and Arts Northwestern Switzerland FHNW, specific meta-rules for a chat bot (called GOODBOT) were formulated that can be transferred to humanoid and other robots [7]. They remind us of the famous Three Laws of Robotics in the short story "Runaround" by Isaac Asimov, published for the first time in 1942 [3], but they are far beyond that. The meta-rules are the following:[4]

1. The GOODBOT makes it clear to the user that it is a machine.

2. The GOODBOT takes the user's problems seriously and supports him or her, whereever possible.

3. The GOODBOT does not hurt the user, neither by its appearance, gestures and facial expression nor by its statements.

4. The GOODBOT does not tell a lie respectively makes clear that it lies.

5. The GOODBOT is not a moralist and indulges in cyberhedonism.

6. The GOODBOT is not a snitch and does not evaluate the user's talks.

7. The GOODBOT brings the user back to reality after some time.

The meta-rules were implemented successfully in a prototype, after some adaptions by the involved students. As in the Three Laws of Robotics, there are problems and contradictions. What, if the GOODBOT causes hurt, when it tells the truth? What, if the GOODBOT uses the IP address to provide a national emergency number (which is actually the case) – is it therefore a spy or not?

In the present context, these meta-rules are a viable, but not a sufficient guideline. They must be modified and completed in general and in more specific details. The robot as a

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[2] It is not surprising that a new kind of care, so-called sex care, is establishing. Of course, the focus is on human sex workers, not on robots.

[3] There are also many care robots which are closer to industrial robots. Of course, the androids attract more attention than the others.

[4] The sentences were translated by the author of this contribution.

material entity can physically interact with things.[5] Accordingly, it may be required of a robot, for example, that it should not physically hurt the people who use it. Surgical robots, of course, could not fulfill their purpose without inflicting injuries. However, the meta-rules can serve as a backdrop or an orientation.

ACTIONS, APPEARANCE AND LANGUAGE SKILLS
In the following tables, various problem areas are represented, distinguishing between MCR in general and specific types of robots. In the cases of appearance and language skills this contribution concentrates on therapy, care and sex robots. The perspective of machine ethics is predominant, but technology ethics and information ethics as well as medical ethics are also relevant.

The table for the actions contains the following points:

Type	Problem areas: actions
MCR	Does the robot hurt its users or any other persons, e.g. by its mobility or the movement of its limbs?
MCR	Does the robot's behavior threaten the patients' autonomy, e.g. by holding them or by preventing their movements and actions?
MCR	Are the robot's decisions concerning the patient technically and factually wrong and as a consequence harmful for him or her?
Surgery robot	Does the surgery robot cause fear and suffering by its (irritating) movements and (opaque) actions?
Therapy robot	Is the therapy robot overwhelmed by its goals, such as helping and healing the patient?
Care robot	Is the care robot overwhelmed by its tasks, such as transferring the patient to another bed?
Sex robot	Does the sex robot touch the human being in an inappropriate way, so that he or she feels abused?

Table 1: Areas of concern in relation to actions

The table concerning the appearance contains these points:

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[5] In this context, elements of the actor-network theory may be relevant [12]. Not only persons can be subjects of actions and relationships, but also animals and machines.

Type	Problem areas: appearance
MCR	Is the robot's appearance discriminating against its users or any other person, e.g. because of the color of its skin, the shape of its head or the design of its face?
MCR	Is the robot's facial expression or are its gestures offensive or hurtful in the corresponding country or context?
MCR	Does the design of the robot compromise the relationship between machine and man, e.g. by frightening or disgusting the patient?
Therapy robot	Does the appearance influence the therapy in a negative way and prevent its success?
Care robot	Is the care robot designed in a user-unfriendly way, so that the human being is stressed or overstrained?
Sex robot	Is the appearance of the sex robot inappropriate, e.g. due to its manifestation in the form of a child?

Table 2: Areas of concern in relation to the appearance of the robot

The table concerning the (natural) language skills contains the following points:

Type	Problem areas: language skills
MCR	Do the robot's statements, e.g. jokes about people, races, gender and physical condition, discriminate against its users or other persons?
MCR	Does the robot inadequately react to statements of the user, such as "I want to kill myself" or "I want to kill people", by withholding aid?
MCR	Does the robot tell the patient a lie even though he or she wants to know the truth, or does it tell her or him the truth, although it could harm her or him?
MCR	Does the robot analyze and evaluate the statements of the users and pass the data to others, such as doctors or representatives of health insurances?
Therapy robot	Does the therapy robot upset or discourage the patients owing to a too simple or too complicated diction or unintelligible sounds and phrases?

Type	Problem areas: language skills
Care robot	Does the care robot ignore orders of the patients or does it prefer orders from un-authorized persons and machines?
Sex robot	Is the voice of the sex robot unreasonable in any sense, e.g. because it has the voice of a very young girl or boy?

Table 3: Areas of concern in relation to the (natural) language skills bot

The problem descriptions allow those interested in robotics, computer scientists, and designers, to take into account social and moral aspects and to avoid certain pitfalls.

It is important to match the results with existing guidelines such as this framework for the design of care robots:

Context – hospital (and ward) vs. nursing home vs. home

Practice – lifting, bathing, feeding, delivery of food and/or sheets and/or medications,

Actors involved – nurse and patient and robot vs. patient and robot vs. nurse and robot

Type of robot and robot capabilities – assistive vs. enabling vs. replacement

Manifestation of care values – Attentiveness, responsibility, competence, responsiveness

Table 4: The care-centered framework by [17]

CONCLUSION AND OUTLOOK

The meta-rules and the problem descriptions in this contribution are one step towards a framework for the development and design of moral MCR. However, there is still much to be done: The meta-rules have to be further adapted to the physical world of robots, and the problem descriptions have to be further adapted to cultural characteristics and individual requirements.

Thus, the case should not be put for relativism. It is rather about such a framework providing important clues which can be checked and used in the respective context, and in the relevant practice. Last but not least, the part of the specific robots has to be replenished with further issues and to be substantiated in order to become a clear guideline for the developers and designers.

The principle of ethics lies not only in dispute, but – already with Aristotle and Epicurus – also in design, namely that of a good, happy life. In this context, it needs additional indications as to the principles how such a life should look like,

and how the development and the design of moral MCRs could contribute to this.

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