Diskussionen wurde deutlich, dass noch nicht geklärt ist, ob dezentrale Wassersysteme insgesamt tatsächlich weniger Kosten verursachen als zentrale Systeme. Nach Holländer entsprechen die Kosten für die Überwachung und Steuerung bei großen zentralen Anlagen nur einem geringen Teil der Gesamtkosten, wohingegen bei kleinen Anlagen derzeit noch mit erhöhten Kosten für Betrieb und Qualitätsüberwachung zu rechnen ist.

Das Beispiel des Sarigerme Parks veranschaulicht, wie in sensiblen Gebieten (Tourismusresorts, Inseln, Naturparks etc.) Abwasser und Abfälle gezielt am Ort der Entstehung behandelt werden können. Darüber hinaus wird gezeigt, wie durch die Kopplung mit der Erzeugung regenerativer Energie ein nahezu geschlossener Kreislauf entstehen kann.

Anmerkungen

1) DEUS21 ist das Akronym für "Dezentrale Urbane Infrastruktur-Systeme"; nähere Informationen zum Projekt sind verfügbar unter http://www.isi.fraunhofer.de/n/Projekte/deus.htm
2) MODULAARE steht als Akronym für „Integrierte Module zur hocheffizienten Abwasserreinigung, Abfallbehandlung und regenerativen Energiegewinnung in Tourismus-Resorts / Türkei; Teilvorhaben 1". Nähere Informationen zum Projekt sind verfügbar unter http://www.iswa.uni-stuttgart.de/awt/forschung/forschung_modulaare.html.

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Workshop of the ETHICBOTS project

Ethics of Human Interaction with Robotic, Bionic, and AI Systems: Concepts and Policies

Naples, Italy, October 17 - 18, 2006

Conference report by Satinder Gill, Middlesex University, and Guglielmo Tamburrini, Università di Napoli Federico II

1 Background and Organisation

The workshop, organized in the framework of the European project ETHICBOTS[1], explored ethical issues arising from human interactions with adaptive and cognitive systems developed in the framework of Robotics, Bionics, and Artificial Intelligence (AI). The initial intuition motivating this workshop was that interactions of humans with adaptive and intelligent systems which are themselves machines (robots or softbots – intelligent software agents) or comprise machine parts (bionic systems), require novel and unified analyses from a perspective of applied ethics perspective. Adaptive and intelligent systems that are as a whole or in some of their parts identified as machines are a relatively recent acquisition of human scientific and technological undertakings. Human beings experience cognitive (and more generally mental) interactions with these systems in a way that cannot be experienced with any non-human biological system that is known to us as capable of adaptive and intelligent behaviours.

Ethical issues addressed in the workshop presentations included the following six topics:

- fair access to adaptive and intelligent machinery resources;
- machine autonomy and precautionary policies;
- responsibilities for cooperative human-machine deliberation and action;

- preservation and promotion of fundamental human rights;
- individual and societal impact of human-machine cognitive and affective bonds, and
- intercultural aspects of robot and softbot design and use.

A multidisciplinary group of about 50 participants, aptly including roboticists, computer scientists, anthropologists, sociologists, moral philosophers, theologians, and philosophers of science took part in this workshop; eight invited plenary papers were delivered during the first day, and two parallel sessions for 19 contributed papers took place on the next day.

As it is not possible to comment here on each one of the 27 workshop presentations, we will concentrate on a few presentations that jointly provide a comprehensive picture of the variety of topics addressed during the workshop.[2]

2 Presentations: A Selective Overview

In his presentation on *"The social impact of Intelligent Artifacts"*, R. Rosenberg (University of British Columbia) lamented that while biologists have to explain why research on cloning, for example, will have long-term benefits, such concerns rarely arise in AI: it seems to be taken for granted that benefits to society of intelligent artefacts are so obvious that critical review is unnecessary. Rosenberg challenged this viewpoint by referring to a variety of AI applications and, in particular, concentrating on current threats to privacy by AI systems which may find ready application in intelligence activities, such as automatic interpretation of tape recordings and cross-correlation of electronic files.

In his presentation on *"Technology as an excuse for questionable ethics"*, A. Mowshowitz (City University of New York) emphasized that no technology is in itself dehumanizing or alienating. He claimed that reification of technology veils human shortcomings: by endowing technology with the power to wreak havoc, human beings are ethically sidelined and relieved of responsibilities. In order to counter this tendency, one should be careful to trace back the responsibilities of human beings for improper uses of AI and ICT technologies which lead, for example, to invasion and violation of privacy in the information society.

The human responsibility issue was taken up again, this time in connection with the actions of learning systems in robotics and AI, in the presentation *"Learning automata and human responsibilities"* by D. Marino and G. Tamburrini (Università di Napoli Federico II). Moral responsibility and liability ascription problems concerning damages caused by learning robot actions were discussed in the light of epistemic limitations concerning prediction and explanation of the behaviour of learning automata. The difficulty of shaping appropriate responsibility ascription policies for robot and softbot actions was emphasized by reference to the fact that these machines – by combining learning with autonomy, pro-activity, reasoning, and planning – can enter cognitive interactions that human beings have not experienced with any other non-human system.

In his presentation *"Replaceability of Humans by Autonomous Robots?"*, M. Decker (ITAS, Forschungszentrum Karlsruhe), reported on the recommendations for actions developed in the context of a project on this topic, that involved monthly meetings of an interdisciplinary group of experts over a period of two years.[3] Ethical issues played a prominent role in connection with the recommendation concerning "position of humans in the hierarchy of steering functions". Decker appealed to an ethical principle of "Kant's formula of humanity" to claim that human beings should be at the top of the hierarchical control system in human-robot interactions. Moreover, Decker emphasized the need for combining ethical reflection with technical, legal, and economic considerations in order to arrive at concrete recommendations for action concerning "liability for robots", "learning robots and their equipment", and "assistance robots in human care".

In the same vein, A.K. Mackworth (University of British Columbia) examined the relationship between technical considerations and ethical reflection in the shaping of robot design approaches. Making ethically motivated choices about any of our mutual interactions with robots presupposes that we are able to foresee possible future effects of that interaction. Thus, an ethical consideration imposes strong requirements on the design space for the models we use to repre-

sent robot architectures: we cannot use ad hoc or opaque models of robot structure or function, for we need to be able to determine if a robot will satisfy ethically motivated constraints on its future actions.

P. Salvini, C. Laschi, and P. Dario (Scuola Superiore Sant'Anna, Pisa) in their presentation entitled *"Exploring Techno-Ethical Issues in Bio-Robotics Technologies"*, provided an informative survey of some current developments in robotic prosthetics and brain-machine interfaces. They identified in the problematic distinction between augmentation of human capabilities and restoration of lost functions the source of critical ethical issues concerning bionics research in general, and prosthetic devices in particular. The possibility of drawing an empirically meaningful demarcation between augmentation and restoration was challenged by K. Warwick and D. Cerqui (University of Reading) in their presentation "Therapy versus enhancement in brain-computer integration". This claim was chiefly supported by an analysis of experiments carried out in the field of invasive brain-computer integration.

The related need for distinguishing between medical and non-medical uses of ICT implants in the human body was examined by S. Rodotà (Università di Roma La Sapienza) in his presentation *"Adventures of the human body"*. His analysis made crucial reference to the right to physical and mental integrity (emphasized in Article 3 of the Charter of Fundamental Rights of the European Union), and was carried out in the light of the opinion rendered in 2005 by the European Group for Ethics in Science and New Technologies (EGE) of the European Commission, concerning ITC implants in the human body. Notably, Rodotà endorsed and commented on the following conclusions reached by the EGE: that the existence of a recognised serious but uncertain risk, currently applying to the simplest types of ICT implant in the human body, requires application of the precautionary principle; that medical applications should be evaluated stringently and selectively, partly to prevent their being invoked as a means to legitimise other types of application; that the data minimisation principle rules out the lawfulness of ICT implants that are only aimed at identifying patients, if they can be replaced by less invasive and equally secure tools; that the proportionality principle rules out the lawfulness of implants such as those that are exclusively used, for instance, to facilitate entrance to public premises; that the dignity principle prohibits transformation of the body into an object to be manipulated and controlled remotely.

Rafael Capurro (Hochschule der Medien, Stuttgart) explored broad *"Methodological issues in the ethics of human-robot interaction"* which crucially involve consideration of the social dimension of the ethical discourse: For whom and by whom are robots and softbots being developed? Who fits the standards that robots and robotic devices like AIBO, Pino, Paro, Kismet etc. embody? Do they contribute to deeper equality, keener appreciation of heterogeneous multiplicity, and stronger accountability for liveable worlds? And what is the effect of such entities on those who do not have access to them? According to Capurro, ethical reflection should also support strong democratic participation and citizen activity in the process of creating these techno-scientific artefacts. A central problem here concerns the specification and implementation of an interdisciplinary process involving engineers and technology designers in the public discussion.

The new conditions of interaction that come with the integration of intelligent interactive artefacts (multi-modal and multi-sensory) may impact on essential aspects of being human, such as social intelligence and our capacity to synchronise and coordinate with others and perform collective action. In her presentation on *"Technoethical issues of cognition and communication"*, Satinder Gill (Middlesex University, London) considered these human capacities as being essential to social cohesion. She gave the example of human "coordinated autonomy". Autonomy is a concept that can be misunderstood as meaning the 'individual', and systems built on this principle may impact on human cognition and communication in a manner that does not afford co-evolution in the symbiotic interactive structure. This concept of autonomy needs to be rethought as existing in the social dynamics of everyday life where, for example, the rhythmic coordination of our bodies and voices enable us to ground our understanding of any communicative situation. Interactive 'intelligent' technologies impact on coordinated autonomy as we engage with them and via them

in ways that are not possible for us to control because this basic human capacity operates at a tacit level. For example, it may be harmful to subject a very young child or baby to an interactive technology that impinges on their development of social interaction with others. The socio-ethical concerns within technoethics lie in the impacts on social / cultural cohesion, learning (social cognition), inclusivity.

3 Discussion and Future Developments

Workshop discussions between participants were aimed at ethical problems that give us cause for concern at the moment (e.g., the use of bionic implants for social/cognitive/control purposes, and the prospect of robot soldiers). They also covered ethical problems that may give us cause for concern in some distant future (e.g., machine consciousness and the ethics of our responsibilities to treat machines as we do humans). A more focused approach, as many participants emphasized, presupposes a careful triage of extant work in the fields of robotics, bionics and AI, conducted with the aim of identifying those technologies, projects, and systems that more urgently call for ethical reflection. Imminence, novelty, and expected social pervasiveness were identified as significant dimensions for an effective triage.

Notes

1) ETHICBOTS is the Acronym for "Emerging Technoethics of Human Interaction with Communication, Bionic, and RoBOTic Systems", a EU Coordination Action within the programme "Science and Society" of FP6 with a duration of two years. For further information on the project and the project consortium see http://ethicbots.na.infn.it.
2) The interested reader can find an extended abstract of every presentation at the website http://ethicbots.na.infn.it/meetings/firstworkshop/abstracts/abstracts.htm. For a paperbound copy of the workshop "Book of abstracts", please contact Guglielmo Tamburrini (tamburrini@na.infn.it).
3) The title of this project was "Robotik. Optionen der Ersetzbarkeit des Menschen".

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For this conference report the author chose an unconventional format. Besides the reporting of the workshop he reflects central results in the context of his sociological perspective and discusses strengths and shortcomings. Comments on this report are welcome

(the Editor)

Learning of Talk?

Report and discussion on the closing workshop of the ELSA project "Let's talk about GOLD!"

Vienna, Austria, September 21 - 23, 2006

by Christian Büscher, ITAS

The project „Let's talk about GOLD!" is a research project of the Accompanying Research Programme ELSA[1] within the Austrian Genome Research Programme GEN-AU[2]. The ELSA-programme addresses the issue of yet unknown consequences related to scientific knowledge production. For precautionary reasons the knowledge production should be accompanied by ethical reflections and a public engagement to include the social dimensions of techno-scientific development. In that sense the Austrian GEN-AU Initiative claims: "Every step towards the future has social implications. Some applications arising from genome research, and the way they are handled by society, are presently raising questions. For this reason, in the context of GEN-AU, issues such as (among others) genetic testing, data protection, patents, and prenatal diagnostics will be publicly discussed."[3] GEN-AU is therefore funding research projects in the genome field for future technological innovation and simultaneously research projects for technology assessment with a variety of disciplines and methods. The closing workshop of "Let's talk about Gold" had the title "Engaging Science and Society in the Ethics of Genome Research". It was organized by the Department of Social Studies of Science at the University of Vienna and the Interuniversity Research Centre for Technology, Work and Culture (Graz).

1 The Project and its Methodology

„Let's talk about GOLD!" has literally initiated a dialog between scientific experts of the GEN-AU funded project "GOLD" (Genomics of