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Robotics: "A New Way of Lifestyle"

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ABSTRACT: The expansion of human capability through emerging technologies resulting from converging developments in advanced robotics, information technology, and thus the cognitive sciences has served as some extent of fascination for literature and therefore the box office alike, but it's also transforming the landscape of up so far medicine, science, and technology. Developments in robotics over the past few decades in manufacturing, shipping, and military applications have already begun to profoundly reshape these industries. Similarly, the healthcare, service industries, and thus the transportation sector are poised to hitch this robotic revolution through the increasing sophistication of surgical robots and other robotic caregivers. Given the vast potential of this type of emerging technologies, this entry explores the field of robotic technology across an honest range of industries and thus subsequent discourse of robot ethics to believe if there are inherent concerns or dangers within the use of these emerging technologies. Additional attention is given to moral considerations and social implications of these technologies, also on legal and other policy questions raised with regard to regulating robotics for the general public good.

KEYWORDS: Robotics, Applications, Future of robotics .

I. INTRODUCTION

Humans have long been fascinated with artificial life, mechanical devices, and automatons. The automata of Greek mythology (especially those created by Hephaistos of Homer's Illiad), golems of early Jewish literature, Leonardo da Vinci's mechanical knight (circa 1495), and Mary Shelley's Frankenstein (early 1800s) stoked the fires of the imagination through a Promethean achievement, homo faber, as creator of artificial life (Lin et al. 2012). In the modern era, the prominence of robots at the World's Fairs of the 1930s in Chicago and New York (i.e., the Fountain of Science in 1933 and Elektro in 1939) heralded the achievement of humanity's industrial and technological capabilities come of age, standing at the cusp of a technological parallel to the Manifest Destiny. In the contemporary context, the emergence of such robots as Honda's ASIMO (introduced in 2000) and more recently Aldebaran Robotics' NAO (launched in 2004), along with rising interest in such cultural phenomena as the RoboCup and the popularity of films such as Blade Runner; A.I.; I, Robot; and the Terminator franchise, has demonstrated a perennial curiosity in the prospect of humans creating artificial life and particularly humanoid robots.

While the concept of robots is not of recent origin, technical developments over the past few decades in advanced robotics, information technology, and machine learning have positioned robots among several emerging technologies with rising significance for present and near-term ethical consideration. The purpose of this entry is to explore the historical background of robotics; clarify key terminology; examine the landscape of contemporary research, development, and application of robotic technology; and conclude with a discussion of various social, legal, and ethical considerations raised by robotics.

II. RELATED WORK

Many experts note the challenges in offering a precise definition of "robot" (Krishnan 2009; Rizza 2013; Lin et al. 2012). Krishnan (2009) suggests this is a result of the complex historical interweaving between the

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much older historical concept of automata and the notion of robots that emerged with Čapek's R.U.R. as these reflect differing interests in the broader category of artificial life. Much of the contemporary understanding of "robot" has moved away from organically based autonomous agents (or what is sometimes referred to as "soft robots" or "wetware") to a more mechanical conception (or hardware model).

In this more contemporary sense, "robot," according to Krishnan (2009), is "defined as a machine, which is able to sense its environment, which is programmed and which is able to manipulate or interact with its environment" and "therefore reproduces the general human abilities of perceiving, thinking, and acting." This definition distinguishes robots from a "simple remote-controlled device," requiring that they. Robots may come in any size or shape (not requiring a set form or semblance to any living organism), and as technological capability continues to evolve and converge with nanotechnology and biotechnology, the meaning of the term robot could become even more diverse (Krishnan 2009). Indeed, while much of robotic design has been patterned after human likeness or the likeness of other organisms, functional design philosophy has led increasingly to a wide spectrum of robot forms.

As Krishnan identifies, the concept of autonomy is a key aspect of contemporary robotics and incorporates the strong emphasis on machine learning or AI research and development. Rizza (2013; cf. Matarić 2007) similarly argues for an understanding of autonomy (even if defined on a continuum), specifying that "a robot is a programmable machine incorporating any degree of artificial intelligence allowing for some degree of autonomy and an ability to sense, perceive, and act in or on its environment." While robots may express a wide range of capabilities in these regards, the three qualities of autonomy, perception, and responsiveness are often utilized as broad criteria for identification. To clarify the spectrum of autonomy that may be manifested by robots, Rizza (2013) distinguishes two distinct types: (1) supervised autonomy that includes "nonautonomous systems with significant AI algorithms aiding human decision making" and (2) learning autonomy, which he defines as a "machine having been programmed to learn from and respond to its environment, and [that] operates without further human intervention.

III. ROLE OF TECHNOLOGY ASSESSMENT

Beyond the more narrow areas of risk assessment and analyses to assess effectiveness and economic impact, emerging technologies such as nanotechnologies should also account for the broader context of technology assessment. Accordingly, Henk ten Have (2007) has noted that technology assessment should include a "broader conception" that takes into consideration "the social and ethical consequences of technologies." This broader conception may include an examination of "the value judgments at play in recommendations and determine if and how those recommendations were not simply scientific but also normative" (ten Have 2007).

Such considerations must go beyond the technology itself in its technical dimensions to examine values that are underlying or inherent within the technologies or to assess whether the technologies are "justified in the light of moral values" (ten Have 2007). This is particularly important in advanced technology arenas such as robots that derive from among other things advances in information and communication technologies. Such broader approaches to technology assessment include what is often referred to as science, technology, and society (STS) and examine such considerations of technological ontology and thus the value-ladenness of technologies, as well as the individual and social implications for humanity (Verbeek 2011; Turkle 2010). These broader concerns of technology assessment seek to examine the possibility of designing and shaping technology to promote values such as community and well-being and what might broadly be conceived of as the good life in an advanced technological age (Brey et al. 2014).

IV. CURRENT AND POTENTIAL APPLICATIONS

Given that robots are so wide-ranging in their applications, what follows is merely a sampling of the various global developments in recent years from some of the more significant industries and social sectors. Such developments emerged initially in the USA in the 1970s but quickly moved to include Japan and Europe and

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later South Korea, Australia, and a much broader international community of research and development (Lin et al. 2012).

1. Manufacturing

For much of the late twentieth and early twenty-first century, the vast majority of early robot applications were industrial applications. From the rise of warehouse distribution machines (e.g., online retailer Amazon's Kiva Systems robots) to increasingly sophisticated industrial manufacturing robots that utilize "train-by-demonstration" technology (e.g., Rethink Robotics' Baxter and Sawyer industrial robots), robots have revolutionized mass-production models of manufacturing across a wide variety of industries such as automotive manufacturing, food production, textiles, electronics manufacturing, fabrication, etc.

Large-scale adoption of manufacturing robots has led to a long-standing concern that robotic technologies replace jobs (Lin et al. 2012; Gerdes 2014). In this respect, robotic automation could be understood in some sense as the logical outcome of mass production and the assembly line model of manufacturing. Others respond that robotic automation improves the overall quality of the workplace environment by removing dangerous, dehumanizing, and/or repetitive activities from the manufacturing process and thus allows for more humane labor conditions. Furthermore, these proponents claim that the deployment of robots requires engineers and other highly skilled technicians to maintain them. Critics respond that with such automation important skills of craftsmanship are lost increasing technology dependence. Regardless of the net sum of individual jobs, the incorporation of robotic automation offers the prospect of increased efficiencies of certain types of labor. Workforce implications of the increased incorporation of robotic automation across all manufacturing industries will become even more pervasive as industrial robots such as Baxter and Sawyer with decreasing retail costs are increasingly incorporated into the existing workforce.

2. Military Robotics

Beyond industrial manufacturing, military robotics is one of the most prominent applications of contemporary robots. Many point to the November 2001 use of a Predator UAV (unmanned aerial vehicle or more commonly referred to as a drone) by the CIA to attack purported terrorists in Yemen as the first use of a military robot as an offensive weapon (Krishnan 2009; Rizza 2013; Capurro and Nagenborg 2009). As of 2009, at least 90 nations were believed to have UAVs in their military arsenals, along with a growing number of nations with less sophisticated robotic weapons, such as cruise missiles (Krishnan 2009). Land-based robots are also at various stages of research, development, and military deployment and include such robots as Big Dog, Crusher, Harpy, and Dragon Runner to assist in supply logistics, offensive and defensive weaponry options, and other various activities, including the BEAR military robot which is proposed for search and extraction activities. As Lin et al. (2012) note, military robots "perform a range of duties, such as spying or surveillance (air, land, underwater, space), defusing bombs, assisting the wounded, inspecting hideouts, and attacking targets."

In less than a decade, US military robots deployed in war zones had grown from virtually zero to over 11,000 by 2009 (Krishnan 2009). With economic incentives such as lower operating costs than manned vehicles and the possibility of more politically palatable military engagements through decreased human troop casualties, expectations for increased reliance upon robotic forces and the future deployment of as yet nonexistent autonomous weapons or "killer robots" seem likely (Krishnan 2009). Indeed, already anticipating these concerns, the US National Defense Authorization Act (NDAA) of 2000 called for one-third of operational deep strike force aircrafts to be unmanned by 2010 and one-third of operational ground combat vehicles to be unmanned by 2015 (Rizza 2013). Subsequent military planning led to the US Department of Defense release of the Joint Robotics Program Master Plan FY 2005 and the subsequent FY2009–2034 Unmanned Systems Integrated Roadmap.

Military robots, though, are not merely reserved for offensive capabilities, but also include a variety of other applications. Several automated air defense systems have been developed such as the Phalanx, Aegis, C-RAM, and Patriot missile systems deployed by the US military (Krishnan 2009; Rizza 2013), as well as the Israeli

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Iron Dome. Additionally, militaries utilize and continue to develop various support and detection robots (e.g., iRobot's Packbot for bomb.

V. CONVERGENCE, AI, AND HUMAN FUTURES

Robots and the convergence of AI as sentient machines frequently appear together in discussions of emerging technologies. In 2002, the National Science Foundation and the US Department of Commerce commissioned the report Converging Technologies for Improving Human Performance that introduced the acronym NBIC (nanotechnology, biotechnology, information technology, and cognitive science) and along with it the convergence of previously disparate fields into a sort of technological singularity. Such convergence the report argued would include exponential increases in the capability to improve health, overcome disability, and even permit human enhancement and post-human technologies including a variety of developments in advanced robotics. Other convergence proposals such as GRIN (genetic, robotic, information, and nano-processes) more explicitly identified the significance of robotics to these developments.

The convergence of such emerging technologies may open exponential leaps forward in such areas as regenerative medicine including nanoscale robots, along with increasingly intelligent assistive devices and other autonomous agents, but more modestly will exacerbate already existing social challenges regarding the pervasive use of information and communications technologies in such areas as privacy, social relationships, and technological moral agency. One particular issue these advances will raise is the challenge to distinguish between humans as agents and technological artifacts, particularly as these technologies are increasingly interactive through direct interfaces such as BCI or cyborg technologies, as well as the development of autonomous robots and the prospect of AI. Speculative proposals for robotics extend into the convergence of neuroscience and the possibility of cognitive uploads into robot avatars.

The prospect of increased HCI by means of advanced prosthetics raises a broader conversation regarding the convergence of technologies and the prospect for human futures. Cybernetic organisms or cyborgs would retain autonomous decision-making capability but raise important considerations regarding the incorporation of technology into the human body and questions of identity in relationship to the human body. As such augmentation incorporates neural technologies, this further complicates questions about identity and person. Existing conversations in neuroethics and philosophy of mind are exploring the implications of outsourcing cognitive processes through proposals such as the extended mind hypothesis. The prospect of semi-intelligent or artificially intelligent robotic devices directly interfacing with human beings raises profound questions about the nature of the human person and identity.

While true AI is not essential to emerging applications for robotics, it offers another area of convergence between machine learning, information and communication technologies, and robotics and one that is given a high degree of interest as such machines become increasingly complex in the interaction with their respective environments and humans. Increasingly sophisticated machine learning systems and the prospect of AI raise profound prospects and existential risks for human futures. As with all areas of emerging technologies, a robust infrastructure for technology assessment is essential.

The threat of AI and robots running amok is a common place in science fiction. From the Terminator film franchise to Daniel Wilson's Robopocalypse (2012), such narratives reflect common nightmare scenarios of robot uprisings breaking free from the control of their human makers. These visions are often said to reflect general uneasiness with the scale of power that is being wielded in the creation of advanced technological artifacts such as robots and the pursuit of artificial intelligence, a fear that the tool will outgrow its maker. At least one response to such possibilities is that all robotic technologies and AI systems be created with a "kill switch" that would allow a human operator to automatically shut down the machine. Of course, such kill switches would raise inherent problems of design vulnerability for military robots created with intentional offensive capabilities and thus may represent only a partial solution (Capurro and Nagenborg 2009). Such apocalyptic scenarios similar to that of the gray goo scenarios with nanotechnology are often raised as speculative ethics, and while they may play a role in technology assessment, care must be taken to utilize such scenarios as if they are necessary outcomes for such technological development.

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The convergence of these emerging technologies also invokes the language of singularity as popularized by Ray Kurzweil and later by proponents of transhumanism or H+. In many streams of transhuman and posthuman thought, humanity takes control of its evolutionary future through its technological prowess, and robots often are envisioned to play a significant role in this respect. For some the notion of human futures ends in the legacy of humanity that is bequeathed to our mind children, the sentient machines humans create and will eventually evolve beyond their human creators (Moravec 1999).

Possibilities of sentient machines and posthumanism along with the convergence of robotics and neuroscience raise important considerations of personhood, human identity, the limits of human nature, and ultimately what constitutes the status of being human. Considerations such as discussion of the common good, human flourishing, and human futures should be brought to bear in an analysis of converging technologies and human enhancement. While perhaps speculative in nature, the possibility of such futuristic technological outcomes should be included as part of a broader analysis of technology assessment when applied to robots. These speculative analyses may be distinct from analyses of presenting technologies but should not be ignored in a more complete analysis of robots as such..

VI. CONCLUSION

Robots have demonstrated the potential to transform the landscape of industrial manufacturing, medical care and therapeutics, and transportation, as well as a wide spectrum of consumer and entertainment applications. As one of several emerging technologies, robots must be carefully examined for their potential benefits along with careful consideration given to immediate concerns for potential risks as well as examinations of the broader impact of such technologies for considerations of human nature and human futures both in their individual and global dimensions. Proper technology assessment of these technologies must explore not only important considerations of risk assessment for safety and security with respect to individual applications but should raise broader considerations so as to anticipate and address social implications that may occur as a result of this rapidly evolving field of technology

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