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Cultural difference in Robotics: Japan and Germany – an overview

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Keywords

Robotic research and development, service robots, humanoid robots, cultural factors

Abstract

Since the introduction of the first industry robots much has happened in the field of robotics since the 1970s. The latest robots are now capable of taking on a variety of tasks nearly autonomously. There are vast differences in approaches to robotics development and encounters to robots through media between Japan and the Western world (represented by Germany), particularly in the field of service robotics, that will be in the focus of this study. In addition, an overview of the cultural background used for comparing Japan and Germany, the robot kingdom and the latest robots research trends will also be covered in detail.

Introduction

There are two different trends in the field of robotics development that are markedly separate into West and East: the development of machine-like robots in Europe and the United States of America, and the interest in humanoid robots in Japan. The reasons for this are mostly based on different attitudes towards technology and cultural environments. The discrepancy between the approaches in Japan and the West becomes apparent in the discussion of problems, which are associated with demographic changes in Japan, i.e. the decline of the working-age population and increasing numbers of elderly needing care, which also is compounded by a shortage of personnel in healthcare fields.

Germany and the West

In Germany, as this study´s representative of the Western tradition of thought, robots have a negative connotation. Major reasons for this are the Christian religion, the robot´s image as communicated by the media and the concerns toward technology.

Referring to the Christian belief system, God is the originator of all life; thus, humans, who are trying to create independent life, are disrupting a divine order. Such attempts are punished, among other things, in the Bible, with negative consequences for human

creators (Ichbiah 2005: 34). According to Christianity in particular, the development of human robots, i.e. androids, is a complex issue. In media and literature, robots have been portrayed very negatively for a long time - with robots often turning against their creators or meting out other punishments. This kind of imagery has entered the Western psyche with a markedly negative influence on current associations towards robots.

In particular the play *R.U.R.* (1920) written by Karel Capek has greatly influenced, and indeed still offers the best display of popular perceptions of robots. Capek wrote his play in the 1920s at a time when fascism and communism were gaining traction in Europe. The word *robot* itself made its debut in *R.U.R.*; it was derived from the Slavonic word *robota*, which means 'labor' or 'forced labor'. The play´s plot involves machines that are created to do work for humans, but at some point these machines turn against their creators and in the end replace humans altogether (Ichbiah 2005: 40-42). Not only did Capek coin the concept of 'robot' itself, but he also created the fear of what robots might be capable of. Other examples of man-made fearsome creatures in this context are found in the film adaptation of Frankenstein (1931) and more recently, Terminator (1984).[1]

To contrast this fear, a completely different view on robotics was introduced in the late 1930s by the science-fiction author Isaac Asimov with his robotic ethics (1938). His novels are about the underlying issues of robotics, which arise from his three laws:

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 to it by human beings, except where such orders would conflict the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws. (Ichbiah 2005: 50-51).

This sophisticated and positive understanding of robotics had a strong influence on the science-fiction literature of the last few decades, with Asimov´s *I, Robot* (1950) earning a recent film adaptation (Ichbiah 2005: 80-84).

[1] A more detailed description of the mentioned movies can be found at Ichbiah (2005) „Roboter. Geschichte, Technik, Entwicklung" on p38-39 for Frankenstein and p.78-79 for Terminator.

Originally robots were merely the fancy of science-fiction literature, but since the 1970s they crossed into tangible reality. With the progress of automation and subsequent breakthroughs in the development of industry robots a great number of autonomously-mobile machines found their way into production facilities. The first of such machines was the *Unimate* created by Joseph Engelberg and George Devol. Devol recognized that many tasks involved in fabric manufacturing consisted of simple lifting actions, which could readily be automated. (Schodt 1988: p.30-35) The design of the *Unimate* consisted of a tank-like machine with an arm at its top. This simple design still influences many industrial robots today.

Unimate (http://www.prsrobots.com/1961.html)

Utilizing the benefits of these kinds of industrial robotics, cheap mass production, while maintaining high quality standards, became an achievable reality. Yet, despite the advantages of industrial robotics, fear/ negative emotions towards robots in Europe and the USA escalated along with the advent of their widespread use. With many people concerned that eventually human workers would face obsolescence and human jobs would eventually meet replacement by machines.

Against a background of demographic change, the use of new technologies is a way to balance out and thus improve the general situation of many industries. With decreases in the numbers of people in the workforce, and a simultaneous increase in the elderly population, Japan faces many difficulties in maintaining its production in a myriad of fields. With more and more Japanese people reaching the age of needing care, the shortage of caregiving staff also poses a serious problem. Whether robotics is the solution to this problem is debatable, but there are undeniable benefits to exploring such measures. These benefits are not limited to industrial robotics, and as such the possible benefits to the care industry are manifold. The negative connotation of robots, however, is still an obstacle in deciding what sort of roles robotics will play in this field, as these robots would interact and communicate directly with humans, i.e. service or entertainment robots.

Regardless of feelings towards humanoid robots, current developments in robotics lean towards more machine-like designs. This is not necessarily due to the negative image of robots, but because many engineers especially in Germany think that function is more

important than design (Gräfe 2010). This is perhaps true in the case of industrial robots used in factories but for service or entertainment robots aesthetics take on a greater importance. For these robots acceptance is a key factor for their applicability and in that context its design is a determining factor of success for specific robots.

Another point may be the state of technology in the field of humanoid robotics development in Germany. Japan is the worldwide leader in the field of bipedal robotics development and will not be overtaken soon. For this reason alone Germany´s avoiding direct competition through an alternative design approach is comprehensible. In Germany well-known service robot projects are *Care-O-Bot*, *CASERO* and *HERMES*.

Care-O-Bot (Rathmann 2010)

CASERO (Rathmann 2010)

Hermes (http://www.unibw.de/fir/roboter/hermes)

Japan

Compared with the Western view on robotics, Japan is a technology-loving country; it could even be termed ‘the country of robots’. The Japanese viewpoint on technology is significantly different from the West´s on the basis of religion, history and popular culture. This difference leads to a much more positive image of robots and robotics.

Since the Meiji Restoration (1868-1912) technology is connected to change. Through the adaption of Western technology it was possible to modernize Japan in a very short period. After World War 2 ended, technology was necessary to rebuild the devastated country back up and return to prosperity. Since the 1970s Japan has become the leader in the use of industrial robots (Schodt 1988: 16). It is then not surprising that Japan calls itself the

Robot Kingdom (Schodt 1988: 13-28) and is the major pioneer in the field of robotics (development).

Japan´s positive view of robotics does not stem only from its positive connotation with progress, but also because the native Japanese religion *Shinto (shintô*; Way of the Gods) has a great influence on the attitude towards inanimate objects, such as vending machines, other machines and robots. According to Shinto it is assumed that even inanimate objects have a soul (*kami*; Spirit) with specific attributes. This contrasts with Christianity which does not recognize such ideas and this discrepancy can attribute to the diversity in perceptions between the West and Japanese.

In this context, the *karakuri* (*karakuri ningyô*; mechanic doll) are another factor that contributed to Japan´s acceptance, and near obsession, with robots. *Karakuri* are machines or automatons that can perform specific movements independently. During the Tokugawa period (1603-1868) they were invented on the basis of watch technology from abroad. The Tokugawa period is widely considered a time of closure and isolation (*sakoku*; locked country) where for nearly 200 years Japan shut itself off from the outside world; here the *karakuri* can be seen as an exception, as their development was seen as important to the entertainment industry and so the technology was permitted to enter the country . The mechanic dolls enjoyed great popularity[2] at festivals and still are used today.

Modern Japanese culture also embraces robots, especially in *manga* and *anime*. In Europe and the United States of America, where movies like Terminator and Frankenstein convey a negative view on robots, Japan portrays robots that are often friends or the helpers of humans. Highly visible examples of this are Astro Boy (1951-1968), Doraemon (1970-present) and Gundam (1979-present) among others.

[2] A wide explanation of the history and significance for the population is given in Wißnet (2007) „Roboter in Japan“ on p.19-34.

Astro Boy (http://tezukaosamu.net/jp/manga/291.html)

Doreamon (http://doraeiga.com/2011/chara/)

Gundam (Rathmann 2010)

Astro Boy (*tetsuwan atomu; Astro Boy*) was invented by Osamu Tezuka. Tezuka's *manga* (*manga*; comic) is about a robot with a soul that wants to be as human as possible. The story is often connected to the positive, or the negative, use of technology; Astro Boy often stands up for the humans and gets into complex situations (see Hornyak/2006, p.48-53).

Doraemon (*doraemon*; Doraemon) is an *anime* (*anime* from Japanese *animeshon*; animation) and *manga* character. The *manga* and *anime* takes place in the present, where Doraemon is a robot that comes from the 22nd century to help his owner master various situations. The robot has many futuristic gadgets at his disposal and though he means well, can often make things difficult for his clumsy owner. Doraemon is immensely popular not only in Japan, but also in other parts of Asia. A Western parallel could perhaps be found in Mickey Mouse.

Gundam (*gandamu*; Mobile Suit Gundam) is an *anime* series from the late 1970s, which has continued in various forms like *manga* and feature films to the present day. The story is about the war between human colonies in space, the need for which was caused by the overpopulation of Earth and thus the need to shift to other living environments. In this war, *gundams*, giant robots that are used to fight, take a central role. The Gundam series is particularly popular among teenagers and young men.

Series like Astro Boy and Gundam have shaped a lasting positive image towards robots in Japan. They influenced both the developers and the public attitude about robotics. Overall, it can be said that through the combination of specific cultural factors like *Shintoism*, *karakuri* as well as pop culture, the predominant attitude towards robotics is one of acceptance and positivity. Especially with regard to service and entertainment robots, the general consensus is interest and desire for further development. Therefore, it is no

surprise that further robotics developments are suggested as an approach to solve problems that are associated with the changes in Japanese population demographics.[3] Against this background the METI (Ministry of Economy, Trade and Industry) declared robotics among the seven key industries for development promotion (see JETRO 2006).

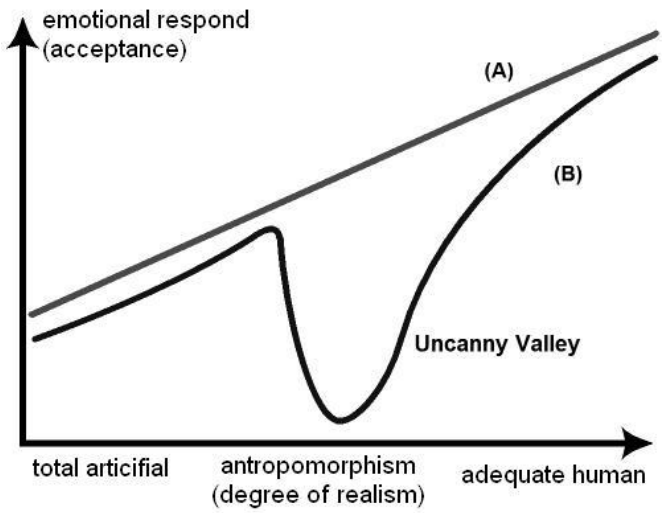
Japan´s society is not just getting older; it is the world leader when it comes to human life expectancy. In tandem with this is a very low birthrate; the number of aging people cannot be balanced through population growth. Due to the country´s extremely complex relationship with the outside world, the number of migrants is extremely low and immigration to Japan is strictly regulated, so a foreign influx in the population is also not an option for growth. For the foreseeable future, there is no reliable source for population increase. With these issues at play, it is not surprising that robotics is discussed as a technical solution for Japan´s social problems and they serve as a high motivator for the further development of robotics. This applies also to not only service robotics, but entertainment and industrial developments as well. For the medium term, robots should be able to interact with and make life easier for aging people. For example, robots should partially compensate for the shortage of nursing staff in elderly care facilities and nursing homes.

Concepts toward the development of humanoid robots in Japan

In contrast to Germany, where design is mostly inspired by machines, Japanese robotic trends tend toward humanoid and more realistic robots. There could even be said to be a Japanese robotic tradition.

With the introduction of the first industrial robots in the 1970s, the initial worry about was about how robots would look. Masahiro Mori´s theory of the uncanny valley (Mori 1970), is considered as one of the most important theories about the design of robots. In general, it should be assumed that the more realistic a robot appears, the greater its acceptance (A). However, according to Mori, at a certain point robots become *too* realistic and their acceptance actually is rejected (B). Many Japanese and also Western robot developers take Mori´s theory into great consideration during their design process.

[3] More details can be found to this topic in the book „*robotto ga nihon wo sukuu*“ by Nakayama (2006).



Uncanny Valley (http://de.wikipedia.org/wiki/Uncanny_Valley)

Mori´s theory influenced Prof. Hiroshi Ishiguro´s research, which deals specifically with the development of android robots.[4] One of his most famous inventions is the *Geminoid*, a remote-controlled communication device. The *Geminoid* works like a human-sized cell phone. The *Geminoid* utilizes hydraulic systems to mimic breathing and facial expressions and it also performs other humanlike functions. The impression it is givining, is that of talking to a real live person. Prof. Ishiguro sees two major advantages in the development of humanoid robots:

1. Humanoid robots can be better used in a human-made society.
2. It is an essential human characteristic, that people have interest in other people, and thus also human-like things. With this basic interest it is possible to create long-term interest in a certain robot (Ishiguro 2010).

In the context of robot development, one fundamental question for Prof. Ishiguro is about human existence and the essential characteristics of humanity itself.[5] Here he sees robotics research as a kind of mirror, because people must realize the difference between human and robot (Ishiguro 2010).

[4] A detailed explanation in androids and their research is provided in Ishiguro's monograph (2007) „andoroidosaiensu – ningen wo shiru tameno robotto kenkyu".

[5] Basic differences between human and robots are covered in Ishiguro (2009) „robotto toha nanika – hito no kokoro wo utsusu kagami"

Geminoid (Rathmann 2010)

Telenoid (Rathmann 2010)

Moreover Prof. Ishiguro assumes a lot of applications for robotics, especially in the field of communication. Much like the *Geminoid*, the *Telenoid* can be used as a mobile phone replacement. Using the *Telenoid* it should be possible for older people to make calls to their relatives living abroad, or another use could be real language teaching with a language teacher via the internet.

Other well-known Japanese projects that deal with humanoid robots are *Wakamaru*, *ASIMO* and the *Toyota Partner Robot*.

Wakamaru (Rathmann 2010)

ASIMO (http://asimo.honda.com/gallery)

Toyota Partner Robot (http://www.toyota.co.jp/en/special/robot/)

Concepts related to the development of service and entertainment robots in Japan

Another direction of research in Japanese robotics is animal-shaped robots. *AIBO* and *Paro* are probably the best known representatives of this genre.

With *AIBO* Sony had developed a robot that could be sold in large quantities. The goal was to create a robot for everyday use, giving buyers the opportunity to have a pet-like robot. The project and sale of *AIBO* ceased in 2006, even though 150.000 robots had been sold (Hornyak 2006: 86).

The other major player in animal robotics was *Paro*. Inventor Dr. Takanori Shibata consciously decided on seal-like shape for *Paro*. Shibata was aware that the necessary technical capabilities had not yet been made to create a dog robot in a convincing way. Consumers would have specific expectations for a dog-, or even for a human-robot, and meeting these expectations is particularly difficult (Shibata 2010). Instead choosing the seal design, Shibata was able to successfully create a robotic animal whose behavior would not really fit, or not fit, consumer expectation. Paro´s main purpose is to mimic animal therapy, particularly to offer comfort to the elderly and it was designed for long-term use. The advantage of *Paro*-like robots is great, as it alleviates costs of maintaining care-animals and offer benefit with regards to hygiene as well.

AIBO (Rathmann 2010)

Paro (Rathmann 2010)

Robot-assisted therapy and its benefits are the particular research of Prof. Toshimitsu Hamada and Prof. Mitsuru Naganuma. They are using *AIBO* and *Paro* to examine their effects on the elderly residing in nursing homes. Other approaches of robotics for the healthcare system are, for example, medical assistance systems such as *HAL*, or the nursing robot *Riba*. *HAL* is currently being implemented as an assistant in rehabilitation for patients after injury or surgery. *Riba* helps nursing staff to relieve their physical burden, such as lifting people out of bed into a wheelchair.

Riba (Rathmann 2010)

HAL (http://www.cyberdyne.jp/english/robotsuithal/)

Conclusion

The Japanese robotics research landscape is rich in diversity; there is also much research conducted in the implementation of robotics with direct interaction with humans. Due to cultural influences like religion, pop culture and technologic tradition, it seems that robotics

development are slowly becoming more acceptable as mainstream options in a changing world. Service and entertainment robots are gradually becoming a stronger presence especially in Japan.

By comparison Germany stresses robot function over design, particularly when it comes to the application of robots in a human environment. This implies a need for robotics to be legitimized by their expected benefits. The fundamental issue of robots as fearsome creatures needs to be further debunked to allow a greater range of ideas to come forth in the current industry.

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