

Humanoid Robots – Towards Learnable Technologies

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Abstract: The paper deals about the state of the art in the humanoid robotics field and the primary challenge is to setup a Humanoid Robotics domain as a test bed for developing a complex system working in various environments and using the concept of learnable technologies in principle. New trends in humanoids robotics brings unique and new views about implementation of learnable technologies. The implementation of learnable technologies Humanoid robotics will bring a very wide social feedback to society and everyday life in information society.

Keywords: humanoid robotics, ASIMO, QRIO, neural networks, Alife, Multiagent systems

1 Introduction

Humanoid robotics is no more a fiction full of mysteries but a real scientific discipline. It is a great challenge for mankind and it was a dream of number of generations and also generations to come. In the current the state of the art we can state that the realization of the dream have become now!!! It is no more a fantasy. There are number of basic concepts in humanoid robotics supported by various companies e.g. Honda, Sony and some others. There are number of problems already solved in this domain e.g. bipedal walking technology and number of problems are challenging for research community to be solved. Humanoid robotics must open to other research community with the common global goal to create an intelligent systems with high degree of autonomy. Is it a good goal for a mankind? It is very difficult question but we must state that it is very exciting and full of questions and discussions about use and missuse of humanoid robotics.

2 The State of the Art in Humanoid Robots

2.1 Research Domain of Humanoid Robots

The Humanoid Robotics is organized research community with the background of machinery robotics and with number of indications that it will be pretty soon a really developed community. The community is in the phase of rapid development and there are number of events worldwide which are supporting these activities. The World Symposium about Humanoid Robots are organized every year and the this event is trying to unify a community into a real research and scientific group. There are number of research groups regarding the research of humanoid robots. Between leading groups is a Waseda University Humanoid Robotics Institute led by Prof. Shuji Hashimoto, Computer and AI lab where a AI robotics is led, also Prof. Dario lab in University of Pisa in Italy. Also there are number of groups working in this field.

2.2 Humanoid Robots as a Technological Systems

Humanoid robots are complex cybernetic systems which are simulating humans behaviour and visual similarity is evident. They can be divided into 2 different groups

- Domain oriented – they have ambition to serve a special domain for services and defined number of tasks
- Universal Humanoid robots which are oriented to be able to “live” like GPS – universal General Problem Solvers

Many labs and companies have already developed number of humanoid robots and these robots are able to solve number of interesting tasks including walking procedure which is very well solved with ASIMO – Honda Robot which is developed under strong support of Honda. Also number of other robots were developed including SONY AIBO robot dog which is not a humanoid robot but technologically is very interesting solution and will contribute to the humanoid robots. One of the newest humanoid robots is SONY robot QRIO. QRIO humanoid robot (HR) is a challenging product to ASIMO and means a very important step in the development of HR in everyday life. The main intention of the QRIO is the develop a mentor HR which would be a part of the family. The name QRIO came from abbreviation (**Q**uest of **CuRIO**sity). The SONY also makes an interesting promotional project to bring closer technology to kids and young people “thinking” and therefore starts the extensive common project with UNESCO to promote QRIO and a first humanoid MENTOR robot for help,

assistance and entertainment activities for kids, disable and elder people and for general public as well. (See: http://www.qrioscienceprogram.net/news_en.html)



Asimo Robot



Pino Robot



Meiji University Robot



SONY – QRIO humanoid robot

2.3 Humanoid Robots Control and Autonomy

The State of the Art of Humanoid robots are in controlling robots using various approaches. There are number

- Teleoperation – which is not so easy and number of implementation problems are being solved there including softness and preciseness of trajectories and so on.
- Self-organized operations – these are based on learnable technologie and these are mainly done using artificial and computational Intelligence.

The second mode if HR behavior is very interesting because it is linked to the autonomy of robots. The autonomy is notion which can have 2 solutions in case if the system is not able to solve a problem. These 2 solutions are in principle as follows:

- System will emerge a solution by itself and in fact make a solution based on its own experience
- System will “ask” a Master computer how to solve a problem.

The second approach seems to be the system which is able to help to use incremental learning and avoid unexpected emergence which can lead to unwanted solutions. Also a problem of solution evaluation is a part of autonomy so the question is if the HR will be able to evaluate the solution made by HR itself.

The important project in HR seems to be a PINO project. This project is an OPEN kept project where research people and students can contribute to the “mind” of the system. More information about open PINO project can be found on <http://www.symbio.jst.go.jp/PINO/>.

3 Computational Intelligence and its Role in Humanoid Robots Development

There are number of fundamental problems which can be solved using computational intelligence tools. Basicly the problem of learnability is essencial and builfing Intelligent Systems. Number of different technologies are expected to be able to play and important role. The basic policy is Agent technology using number of techniques including Expert systems, Fuzzy systems, Neural networks, logic programing, and so on for tasks as planing and scedulling, Datamining, pattern recognition and classification and so on.

The most important thing in the development of the HR skills is ability to share knowledge in very fast way and also gather knowledge and information from

various sources and in various forms. The knowledge gathering must be incremental and is very important that the it could be fused and used with other robots as well.

The Center for Intelligent technologies is starting cooperation with Waseda University and we hope to be part of the common projects with Waseda Humanoid Robotics Institute.

4 Social Implication of Humanoid Robots and why is Useful for Students to Work in HR?

The problem of Social Implication of Humanoid is a serious problem. Social Acceptance of Humanoid robots is and will be a very serious process. The Japan Government is strongly supporting of kids acceptance of robots events where kids are interacting with robots. There are number of project about future questions as living facilities for robots living with humans and so on.

There are number of questions about missuse of AI in many aspects in the future and an interesting way is to producing stories about AI impact. We are aware of many military applications and missuse of these technologies in military goals.

HR is a very good test bed for AI and CI problems. The HR is also a complex system which to control is a great challenge. The students working on HR problems can be very useful in creating complex information systems in big companies and also flexible in number of applications worldwide.

Conclusion

The role of this paper is to underline the meaning of Humanoid Robots research and leave a message that this research is underway. Computational Intelligence will play an extremely important role in building intelligent Humanoid Robots. We will also face a music to number of attempt to missuse the Humanoid Robots for military and teroristic goals as well. We must be ready for it in the future.

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