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Evolution of humanoid robotics

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Abstract

This article briefly describes the evolution of the humanoid robotics in recent years which was influenced by improving of software, building materials and robotics technologies in general. The second part is focused on actual options of humanoid robots in the market while the third part unveils more specific details about the NAO robot. It describes the NAO project, history, development, achievements and the characteristics of the project.

Keywords: humanoid robots, nao, robotics

Introduction

Last 20 years were breakthrough in robotic industry. Robots gained many new features and possibilities for movements, communication and autonomy.

New areas of the software and hardware development, anatomy, improvement of power sources and use of lightweight and durable materials for creation of robots opened new possibilities in robotics. For example: thermal, hydraulic and mechanical actuators allow the robots to be more flexible. Cameras and laser sensors allow the robots to perceive the environment. Manipulators based on technology of pneumatic artificial air muscles allow to interact with objects and all of these features are controlled by powerful computer with specialized software. Humanoid robots are being part of human society - they can hear, see, move, they have artificial muscles, and computer brain. They can learn, teach and even (in some cases) act like a human.

Robots are taking a huge part in our life now, helping or replacing people in a lot of different industries. They work in the factories: Cartesian robots, scara (Selective Compliance Assembly Robot Arm) robots, 6-axis robots, redundant robots, dual-arm robots. Arm robots are usually developed for

specific purposes such as welding, material handling, painting and others. Also the automatically guided vehicles could be considered as robots, too. Many types of robots are used in households in services or in healthcare. Therapeutic robots like "PARO" (robotic baby-seal) are quite like therapy with animals. Military robots are used to defuse bombs, transport resources or explore unknown area. And, of course, space robots used on cosmic stations, shuttles and for space exploration. For a common people, humanoid robots are now probably too expensive but as we can see the prices of the robots are slowly dropping and maybe in a few years everyone can buy a one [1].

Humanoid robots available in the market

There are several humanoid robots in the market right now:

ROBOTIS OP - is a humanoid robot created at Virginia Tech's Robotics and Mechanisms Laboratory in collaboration with Purdue University of Pennsylvania and Korean manufacturer ROBOTIS. The main goal of this robot is to be used by developers for education and research because it offers an open platform. ROBOTIS OP costs around \$9600.

iCub - is an advanced social robot, another advantage of this robot that it is also modular so you can buy parts separately. Height is 100 cm and weight is 23 kg, it also has human features as skin, sensors in fingers and palms, complex tendon articulations and actuators and it is able to manipulate different objects. Cost of this robot is quiet high around \$270,000.

ASIMO - latest version was released in 2011 and has improvements in autonomy, capability and also new recognition system. Robot can move in crowded places as shopping malls, train stations or museums. It has skills such as adapt to the environment, walk on any terrain, climb stairs as good as human. Has 130 cm in height and weights 48 kg. The 57 degrees of freedom enable to perform amazing maneuvers and run with a speed up to 6km/h. ASIMO is a most advanced humanoid robot but also the most expensive, the cost is around \$2,500,000 [2].

NAO - a 58 centimeters high, endearing, interactive and customizable robot companion. It was designed to attract people [3]. Oval-rounded minimalist style of the robot gives a significant advantage in social contact with people over the other robots. Nao robot originates from the Nao Project, founded in 2004. The goal was to create easy customizable humanoid robot which can be used for various tasks. For several years, developers have been working hard to create Nao.

On the wave of success Nao project replaced the robot from Sony in the RoboCup tournament in 2007 and later taking part in 2008, 2009 and became the main platform in the SPL (RoboCup Standard Platform League) in 2010. Various funds have begun to fund universities and research groups for more detailed study of using the robots like Nao [4]. Information mentioned above is the reason why Nao gets so much popularity from the robotics community.

NAO robot

At the moment Nao robot has its own operating system and also tools for the development of the behavior of the robot. Robot is equipped with two cameras, motion sensors, Wi-Fi antenna, sensitivity sensors, a microphone and speakers. Nao has 25 degrees of freedom. Nao construction is showed below on Fig1.

As mentioned above the Nao robot has its own development environment called Choreographe. It enables the users to easily create simple algorithms for Nao robot and model robot's behavior. Users can program the robot to fit their needs. But the more

difficult tasks require advanced algorithms and the usage of well-known programming languages such as C ++, Python, Java.

There are many project based on Nao robots. One of these projects is robot motion through the GPS and compass built in the robot in a way that the user can determine the location of the robot and ask him to move to the point on the map which the robot must follow [6].

Another interesting project is "Cat comb". Author of this project used the XBOX Kinect technology projected his movement to Nao.

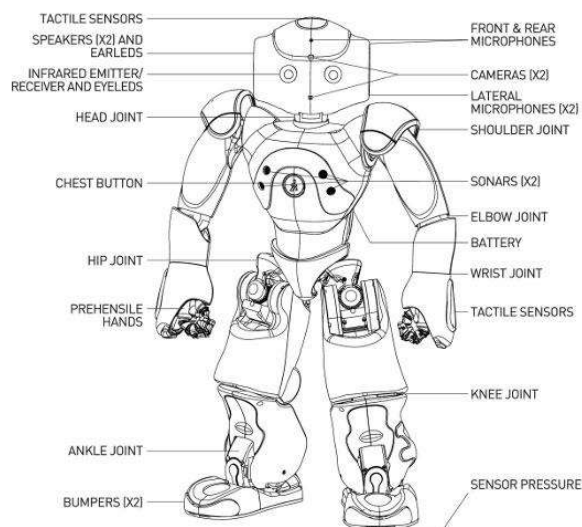


Fig. 1. Nao project concept with specifications [7].

The author managed to control the Nao – the robot easily walked to the author's cat, took a comb and combed the cat [8].

Such projects and many more appear every day in thousands of bright minds of the community. In 2013, the company Aldebaran was acquired by Softbank Mobile for \$100 million US dollars, followed by a change of the company leaders. Therefore, in 2014 Nao project has gained popularity in the scientific community, especially in the robotics community. Various research centers and universities have started to receive grants for research purposes of Nao robots [9]. The Nao project progress timeline is showed in the picture below.

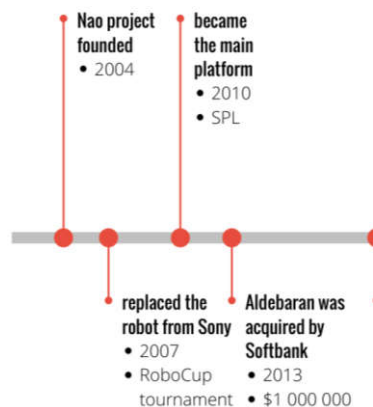


Fig. 2. Nao project key moments timeline.

Further usage

Nao robots are used in many interesting researching projects. For example, a team of French researchers from the University of Lyon stem cells and the brain, under the guidance of an expert CNRS (The National Center for Scientific Research) Peter Ford Dominey, has developed "an autobiographical memory" for the robot Nao, which allow the robot to teach through communication between human and robot [10]. This technological progress could notably be used for operations on the International Space Station or Medical Centers, where the robot would be able to facilitate the work of people who are constantly changing - whether staff or patients Space Station children's therapy center.

Talking about the use of Nao robots in medicine - for the current year use of humanoid robots has more than 300 medical centers [11]. Among them, diabetes care centers, children's treatment centers, rehabilitation centers, kindergartens and hospitals. Such widespread use of these robots in children is due to an interesting feature. After many experiments, it was recorded that children are more susceptible to the appearance of the robot, and more quickly go with it to a contact, than with a man that simplifies the contact between the child - for example, a therapist.

Conclusion

In December 2011, the company produced the version of NextGen Nao robot that allowed to move considerably quicker (new faster optimized walk) also improvements to prevent falling (fall manager, inertial sensor).

Nao robots provide powerful basis for creation and development of artificial intelligence. And even in the near future, on the basis of similar robots, it would be possible to do remotely pilot-

controlled drone robots, that would participate in a life-saving missions, for example.

Nowadays these robots are still mainly used for research purposes. Nao robots open new possibilities not only in the research field but also could help people in the everyday life.

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