Humanoid Robotics

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***Abstract*—This Paper is about *HUMANOID ROBOTICS*. The field of humanoids robotics is widely recognized as the current challenge for robotics research .The humanoid research is an approach to understand and realize the complex real world interactions between a robot, an environment, and a human. The humanoid robotics motivates social interactions such as gesture communication or co-operative tasks in the same context as the physical dynamics. This is essential for three-term interaction, which aims at fusing physical and social interaction at fundamental levels.**

People naturally express themselves through facial gestures and expressions. Our goal is to build a facial gesture human-computer interface from use in robot applications. This system does not require special illumination or facial make-up. By using multiple Kalman filters we accurately predict and robustly track facial features. Since we reliably track the face in real-time we are also able to recognize motion gestures of the. Humanoid Robot technology is one of the fast growing technology is military, health, security, automobiles industries. These robots are playing important role in reducing manual risks and helping doctors to perform risky operations with simple robotic mechanisms. Humanoid Robot is helpful for Human Beings.

I. INTRODUCTION

Humanoid Robotics includes a rich diversity of projects where perception, processing and action are embodied in a recognizably anthropomorphic form in order to emulate some subset of the physical, cognitive and social dimensions of the human body and experience.

Humanoid Robotics is not an attempt to recreate humans. The goal is not, nor should it ever be, to make machines that can be mistaken for or used interchangeably with real human beings. Rather, the goal is to create a new kind of tool, fundamentally different from any we have yet seen because it is designed to work with humans as well as for them.

Humanoids will interact socially with people in typical, everyday environments. We already have robots to do tedious, repetitive labor for specialized environments and tasks. Instead, humanoids will be designed to act safely alongside humans, extending our capabilities in a wide variety of tasks and environments.

At present, Humanoid Robotics is not a well-defined field, but rather an underlying impulse driving collaborative efforts that crosscut many disciplines. Mechanical, electrical and computer engineers, roboticists, computer scientists, artificial intelligence researchers, psychologists, physicists, biologists, cognitive scientists, neurobiologists, philosophers, linguists and artists all contribute and lay claim to the diverse humanoid projects around the world. Inevitably, some projects choose to emphasize the form and mechanical function of the humanoid body.

II. ASIMO: A HUMANOID ROBOT

ASIMO, an acronym for *Advanced Step in Innovative Mobility*, is a humanoid robot designed and developed by Honda. Introduced on 21 October 2000, ASIMO was designed to be a multi-functional mobile assistant.With aspirations of helping those who lack full mobility, ASIMO is frequently used in demonstrations across the world to encourage the study of science and mathematics. At 130 cm (4 ft 3 in) tall and 48 kg (106 lb).

ASIMO was designed to operate in real-world environments, with the ability to walk or run on two feet at speeds of up to 6 kilometers per hour (3.7 mph). In the USA, ASIMO is part of the Innoventions attraction at Disneyland and has been featured in a 15-minute show called "Say 'Hello' to Honda's ASIMO" since June 2005.] The robot has made public appearances around the world, including the Consumer Electronics Show (CES), the Miraikan Museum and Honda Collection Hall in Japan, and the Ars Electronica festival in Austria.

III. STATE-OF-ART

The distinctive feature of full-body humanoids is bipedal locomotion., Walking and running on two legs may seem simple, but humanoid robots still have serious difficulties with it. I see two opposite approaches to bipedal walking. The first-one is based on the zero-moment-point theory (ZMP), introduced by Vukobratovic [1]. The ZMP is defined as the point on the ground about which the sum of the moments of all the active forces Equals zero. If the ZMP is within the convex hull (support polygon) of all contact points between the feet and the ground, a bipedal robot is dynamically stable. The use of the ZMP to judge stability was a major advance over the center-of-mass projection criterion, which describes static stability.

Perception: Humanoid robots must perceive their own state and the state of their environment in order to act successfully. For proprioception, the robots measure the state of their joints using encoders, force sensors, or potentiometers. Important for balance is the estimation of the robot attitude. This is done using accelerometers and gyroscopes. Many humanoid robots also measure ground reaction forces or forces at the hands and fingers. Some humanoid robots are covered with force-sensitive skin. One example for such a robot is CB2 [7], developed at Osaka University.

Although some humanoid robots use super human senses, such as laser range under or ultrasonic distance sensors, the most important modalities for humanoid robots are vision and Audition. Many robots are equipped with two movable cameras.

These cameras are used as active vision system, allowing the robots to focus their attention towards relevant objects in their environment. Movable cameras make depth estimation from disparity more difficult, however. For this reason, fixed calibrated cameras are used for stereo. Most humanoid robots are equipped with onboard computers for image interpretation.

Interpreting real-world image sequences is not a solved problem, though. Hence, many humanoid vision systems work well only in a simplified environment. Frequently, key objects are color coded to make their perception easier.

IV. HUMAN-ROBOT INTERACTION

Many humanoid research projects focus on human-robot interaction.

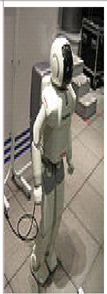
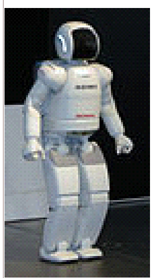
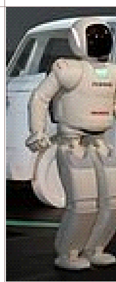
The general idea here is that the efficient techniques which evolved in our culture for human-human communication allow also for intuitive human-machine communication. This

includes multiple modalities like speech, eye gaze, facial expressions, gestures with arms and hands, body language, etc. These modalities are easy to interpret by the human sensory system.Because we practice them since early childhood, face recognition, gesture interpretation, etc. seem to be hard wired in our brains. A smile from a robot does not need much explanation.

Dexterous Manipulation: Another key human capability is dexterous manipulation. The human hand has about thirty degrees of freedom. It is not easy to reproduce its strength, exibility, and sensitivity. Among the most advanced robotic hands are the Shadow hand, which is driven by 40 air muscles [21] and the four-_nger hand developed by DLR and HIT [22]. Dexterous manipulation not only requires capable hands, but also hand-arm coordination and the coordination of two hands and the vision system. Due to the high number of joints involved, controlling grasping and manipulation is challenging.

Three examples for manipulation-oriented humanoid robots are the Robonaut [9], which is using the space tools designed for humans, Justin, for which DLR developed an impedance-based control scheme [23], and Twendy-One, which is equipped with passive impedances in the actuators

V. SPECIFICATIONS

Model	2000, 2001, 2002	2004	2005, 2007	2011	2014
Mass	52 kg	54 kg		48 kg	55 kg
Height	120 cm	130 cm		130 cm	130 cm
Width	45 cm	45 cm		45 cm	
Depth	44 cm	37 cm		34 cm	
Walking speed	1.6 km/hour	2.5 km/hour	2.7 km/hour 1.6 km/hour (carrying 1 kg)		
Running speed	–	3 km/hour	6 km/hour (straight) 5 km/hour (circling)	9 km/hour (straight)	
Airborne time (Running motion)	–	0.05 seconds	0.08 seconds		
Battery	Nickel metal hydride 38.4 V / 10 Ah/ 7.7 kg 4 hours to fully charge	Lithium ion 51.8 V / 6 kg 3 hours to fully charge			
Continuous operating time	30 minutes	40 mins to 1 hour (walking)		1 hour (running/walking)	
Degrees of Freedom	26 (head: 2, arm: 5×2, hand: 1×2, leg: 6×2)	34[29] (head: 3, arm: 7×2, hand: 2×2, torso: 1, leg: 6×2)		57[24][30] (head: 3, arm: 7×2, hand: 13×2, torso: 2, leg: 6×2)	57 (head: 3, arm: 7×2, hand: 13×2, torso: 2, leg: 6×2)
Languages				Japanese only	English & Japanese [31]
Images					

VI. HUMANOID ROBOT APPLICATION

Technology Demonstration: Famous humanoid robots like the Honda Asimo [32] or the Toyota Partner Robots [33] do not accomplish any useful work. They are, however, presented to the media and demonstrate their capabilities like walking, running, climbing stairs, playing, musical instruments or conducting orchestras on stage and during exhibitions. Such a showcase of corporate technology attracts public attention and strengthens the brand of the car manufacturers. Hence, the huge development costs of these advanced humanoids might be covered from the marketing budgets

Conducting an orchestra

Space Missions: Another area where money is not much of an issue is missions to space. Since human life support in space is costly and space missions are dangerous, there is a need to complement or replace humans in space by human-like robots. The two prominent projects in this area are the NASA Robonaut [9] and DLR's Justin [23]. Both use a humanoid torso mounted on a wheeled base. The humanoid appearance of the robots is justified, because they can keep using space-certified tools which have been designed for humans and because the humanoid body makes teleoperation by humans easier.

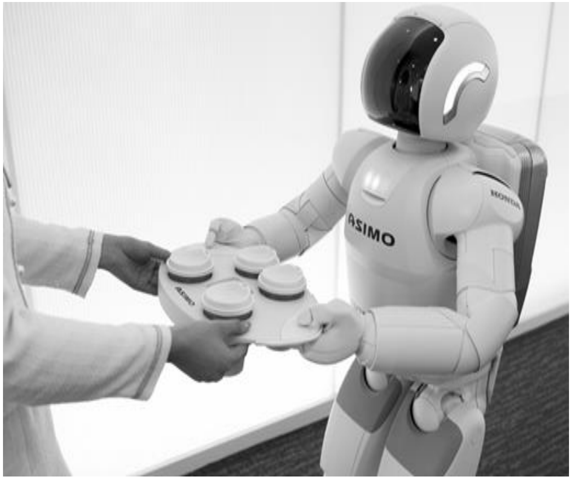
Manufacturing: While in industrial mass production robot arms are used which are not anthropomorphic at all, the Japanese company Yaskawa sees a market for human-like dual-arm robots in manufacturing.It recently announced the Motoman-SDA10 robot [34] which consists of two 7DOF arms on a torso that has an additional rotational joint. Each arm has a payload of 10kg. Yaskawa aims to directly replace humans on production lines. The robot is able to hold a part with one arm while using a tool with the other arm. It can also pass a part from one arm to the other without setting it down. Sales target for the SDA10 is 3000 units/year.

Household: An obvious domain for the use of humanoid robots is the household. Some humanoid projects explicitly address this domain. They include the Armar series of robots developed in Karlsruhe, Twendy-One developed at Waseda University, and the personal robot PR1 developed in Stanford. While these robots demonstrate impressive isolated skills needed in a household nvironment, they are far from autonomous operation in an unmodified household.

VI. NEW TECHNOLOGY IN ASIMO

ASIMO can deliver objects on a tray to a specified destination. By detecting the movement of the person through the eye camera in its head and force sensors on its wrists, ASIMO can move in concert with the person and accurately receive or hand over the tray.

Handing the tray: While carrying the tray, ASIMO uses its entire body to control the tray to prevent spilling of the objects on the tray. Even if the tray slides and is about to fall, ASIMO's wrist sensors detect the weight differences on its hands and automatically stop walking before it drops the tray.



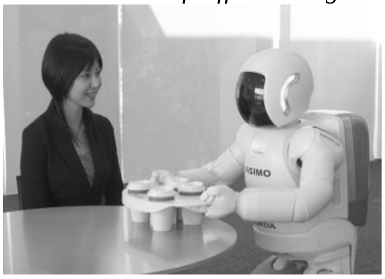
(Handling the tray)

Walking with the tray: When the force sensors on its wrists detect reduction of the load on the wrists as the tray touches the surface of the table, ASIMO sets the tray on the table. By using the entire body to set the tray down, ASIMO can work with tables of different heights.

(Walking with tray)

*Putting the tray on a table:*When the force sensors on its wrists detect reduction of the load on the wrists as the tray touches the surface of the table, ASIMO sets the tray on the table. By using the entire body to set the tray down, ASIMO can work.

With tables of different heights:



Handling a Cart: It can transport heavy loads by handling a wagon in a flexible manner. Being able to handle a cart freely, ASIMO is now capable of carrying heavy objects. ASIMO is capable of handling a cart freely while maintaining an appropriate distance from the cart by adjusting the force of its arms to push a cart using the force sensor on its wrists. Even when the movement of the cart is disturbed, ASIMO can continue maneuvering by taking flexible actions such as slowing down or changing directions. (The maximum load is 10 kg.)

VII. BENEFITS

- Robots offer specific benefits to workers, industries and countries. If introduced correctly, industrial robots can improve the quality of life by freeing workers from dirty, boring, dangerous and heavy labor. it is true that robots can cause unemployment by replacing human workers but robots also create jobs: robot technicians, salesmen, engineers, programmers and supervisors.

- The benefits of robots to industry include improved management control and productivity and consistently high quality products. Industrial robots can work tirelessly night and day on an assembly line without an loss in performance.

- Consequently, they can greatly reduce the costs of manufactured goods. As a result of these industrial benefits, countries that effectively use robots in their industries will have an economic advantage on world market.

VIII. CONCLUSION

Humanoid robot can be used as workers at Exhaustive task. Robots are taking over task which are deemed full, dirty and dangerous. Finally, as the technology improves, there will be new ways to use robots which will bring new hopes and new potential.

Robots are useful in many ways. For instance, it boosts economy because businesses need to be efficient to keep up with the industry competition. Therefore, having robots helps business owners to be competitive, because robots can do jobs better and faster than humans can, e.g. robot can built, assemble a car. Yet robots cannot perform every job; today robots roles include assisting research and industry. Finally, as the technology improves, there will be new ways to use robots which will bring new hopes and new potentials.

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