A Review and Scope of Humanoid Robotics

Yog Maya Shukla¹, Ankit Tamba², Shweta Pandey³, Prabhakar Sharma⁴
¹, ², ³ Student B.Tech Electronics and Communication Department I.T.S Engineering College, Gr. Noida
⁴ Assistant Professor, Electronics and Communication Department I.T.S Engineering College, Gr. Noida
¹shuklamehek@gmail.com
²ankittambaakp_11@its.edu.in
³shwetapandeyakp_eee11@its.edu.in
⁴prabhakar.sh@gmail.com

ABSTRACT: A humanoid robot is a robot with its body shape built to resemble that of the human body. A humanoid design might be for functional purposes, such as interacting with human tools and environments, for experimental purposes, such as the study of bipedal locomotion, or for other purposes. In general, humanoid robots have a torso, a head, two arms, and two legs, though some forms of humanoid robots may model only part of the body, for example, from the waist up. Some humanoid robots may also have heads designed to replicate human facial features such as eyes and mouths. Androids are humanoid robots built to aesthetically resemble humans. Japan, Karel Capek invented the first humanoid robot.


I. INTRODUCTION

- A robot is a mechanical or virtual intelligent agent that can perform tasks automatically or with guidance, typically by remote control. In practice a robot is usually an electro-mechanical machine that is guided by computer and electronic programming.

- Robotics is the branch of technology that deals with the design, construction, operation, structural disposition, manufacture and application of robots and computer systems for their control, sensory feedback, and information processing.

- Robot Types:

Characteristics of Humanoids –
- Self-maintenance
- Autonomous learning
- Avoiding harmful situations to people, property, and itself
- Safe interacting with human beings and the environment
- Legged locomotion

II. BASIC COMPONENTS USED TO DESIGN

- Sensors

A sensor is a device that measures some attribute of the world. Being one of the three primitives of robotics (besides planning and control), sensing plays an important role in robotic paradigms.
Sensors can be classified according to the physical process with which they work or according to the type of measurement information that they give as output. In this case, the second approach was used.

- Proprioceptive Sensors

Proprioceptive sensors sense the position, the orientation and the speed of the humanoid's body and joints. In human beings inner ears are used to maintain balance and orientation. Humanoid robots use accelerometers to measure the acceleration, from which velocity can be calculated by integration; tilt sensors to measure inclination; force sensors placed in robot's hands and feet to measure contact force with environment; position sensors, that indicate the actual position of the robot (from which the velocity can be calculated by derivation) or even speed sensors.

- Exteroceptive Sensors

An artificial hand holding a lightbulb. Arrays of tactels can be used to provide data on what has been touched. The Shadow Hand uses an array of 34 tactels arranged beneath its polyurethane skin on each finger tip.[3] Tactile sensors also provide information about forces and torques transferred between the robot and other objects. Vision refers to processing data from any modality which uses the electromagnetic spectrum to produce an image. In humanoid robots it is used to recognize objects and determine their properties. Vision sensors work most similarly to the eyes of human beings. Most humanoid robots use CCD cameras as vision sensors. Sound sensors allow humanoid robots to hear speech and environmental sounds, and perform as the ears of the human being. Microphones are usually used for this task.

- Actuators

Actuators are the motors responsible for motion in the robot. Humanoid robots are constructed in such a way that they mimic the human body, so they use actuators that perform like muscles and joints, though with a different structure. To achieve the same effect as human motion, humanoid robots use mainly rotary actuators. They can be either electric, pneumatic, hydraulic, piezoelectric or ultrasonic. Ultrasonic actuators are designed to produce movements in a micrometer order at ultrasonic frequencies (over 20 kHz). They are useful for controlling vibration, positioning applications and quick switching. Pneumatic actuators operate on the basis of gas compressibility. As they are inflated, they expand along the axis, and as they deflate, they contract. If one end is fixed, the other will move in a linear trajectory. These actuators are intended for low speed and low/medium load applications. Between pneumatic actuators there are: cylinders, bellows, pneumatic engines, pneumatic stepper motors and pneumatic artificial muscles.

- Planning and control

The iCub humanoid robot at IDSIA's robotics lab in Switzerland trying to reach for a blue cup. To do so it has to plan and control the movement of all its joints in unison. In planning and control, the essential difference between humanoids and other kinds of robots (like industrial ones) is that the movement of the robot has to be human-like, using legged locomotion, especially biped gait. The ideal planning for humanoid movements during normal walking should result in minimum energy consumption, like it does in the human body. For this reason, studies on dynamics and control of these kinds of structures become more and more important.

To maintain dynamic balance during the walk, a robot needs information about contact force and its current and desired motion. The solution to this problem relies on a major concept, the Zero Moment Point (ZMP).

Another characteristic of humanoid robots is that they move, gather information (using sensors) on the "real world" and interact with it. They don’t stay still like factory manipulators and other robots that work in highly structured environments. To allow humanoids to move in complex environments, planning and control must focus on self-collision detection, path planning and obstacle avoidance.
Humanoids don’t yet have some features of the human body. They include structures with variable flexibility, which provide safety (to the robot itself and to the people), and redundancy of movements, i.e. more degrees of freedom and therefore wide task availability. Although these characteristics are desirable to humanoid robots, they will bring more complexity and new problems to planning and control.

III. PURPOSE

TOPIO, a humanoid robot, played ping pong at Tokyo International Robot Exhibition (IREX) 2009.[1][2] Nao is a robot created for companionship. It also competes in the RoboCup soccer championship.

Enon was created to be a personal assistant. It is self-guiding and has limited speech recognition and synthesis. It can also carry things.

Humanoid robots are used as a research tool in several scientific areas. Researchers need to understand the human body structure and behavior (biomechanics) to build and study humanoid robots. On the other side, the attempt to the simulation of the human body leads to a better understanding of it. Human cognition is a field of study which is focused on how humans learn from sensory information in order to acquire perceptual and motor skills. This knowledge is used to develop computational models of human behavior and it has been improving over time. It has been suggested that very advanced robotics will facilitate the enhancement of ordinary humans. See transhumanism. Although the initial aim of humanoid research was to build better orthosis and prosthesis for human beings, knowledge has been transferred between both disciplines. A few examples are: powered leg prosthesis for neuromuscularly impaired, ankle-foot orthosis, biological realistic leg prosthesis and forearm prosthesis.

Humanoid robots, especially with artificial intelligence algorithms, could be useful for future dangerous and/or distant space exploration missions, without having the need to turn back around again and return to Earth once the mission is completed.

IV. FUTURE SCOPES

Humanoid robotics is an emerging and challenging research field, which has received significant attention during the past decade and will continue to play a central role in robotics research. Regardless of the application area, one
of the common problems tackled in humanoid robotics is the understanding of human-like information processing and the underlying mechanisms of the human brain in dealing with the real world.

- ARMAR-IIIa-New-Kitchen-II

Considerable progress has been made in humanoid research resulting in a number of anthropomorphic robots able to move and perform complex tasks. Over the past decade in humanoid research, an encouraging spectrum of science and technology has emerged leading to the development of highly advanced humanoid mechatronic systems endowed with rich and complex sensorimotor capabilities. These include ASIMO, HRP-2, HRP-4C, Toyota’s partner robot DB, CB, ARMAR, iCub, NAO, DARwIn-OP, WABIAN, KOBIAN, Twendy-One, HUBO, Justin, Lola, REEM, Robonaut-R2, Petman and PR2 to name a few. Of major importance for advances of the field is the availability of reproducible humanoid robots systems (HRP-2, HUBO, iCub), which have been used as common hardware and software platforms to support humanoid robotics research.

Ambitious goals have been set for future humanoid robots. They are expected to serve as companions and assistants for humans in daily life and as ultimate helpers in the case of natural disasters. The RoboCup robot soccer organization has also set a goal that in 2050, a team of humanoid robot soccer players shall compete and win against the winner of the most recent World Cup. In 2012, DARPA announced the next Grand Challenge in robotics: building robots which do things like humans in a world made for humans, with a focus on disaster recovery challenge tasks.

Priority areas for the technical committee include:

- Novel materials, devices, mechanisms, energy systems for humanoids
- Principles and technologies for anthropomorphic/bionic design and control
- Whole-body dynamics, control, sensing, informatics
- Software and hardware architecture, system integration
- Teleoperation, tele-experience, tele-presence using humanoids
- Measuring, modeling and simulating humans
- Human and humanoid skills/cognition/interaction
- Humanoid locomotion, manipulation, perception, planning
- Humanoids for human science and engineering
- Adaptation, learning and cognitive development of humanoids
- Neuro-robotics and brain-robot interfaces for humanoids and humans
- Cyborgs, prostheses, assistive devices and sensor/motor suits
- Applications: home, field, space, social, industrial, medical, health/mental care, art/entertainment, education
- Social interaction and acceptability
- Grand challenges, competitions, outreach
- Superhuman humanoids / future humanoids (possibility, technology and meaning)
V. SOME EXAMPLES

2010 REEM, a humanoid service robot with a wheeled mobile base. Developed by PAL Robotics, it can perform autonomous navigation in various surroundings and has voice and face recognition capabilities. In November Honda unveiled its second generation Honda Asimo Robot. The all new Asimo is the first version of the robot with semi-autonomous capabilities.

2012 In April, the Advanced Robotics Department in Italian Institute of Technology released its first version of the Compliant humanoid robot COMAN which is designed for robust dynamic walking and balancing in rough terrain.[46]

2013 In December 20-21, 2013 DARPA Robotics Challenge ranked the top 16 humanoid robots competing for the $2 million cash prize. The leading team, SCHAFT, with 27 out of a possible score of 30 was bought by Google.[47] PAL Robotics launches REEM-C the first humanoid biped robot developed as a robotics research platform 100% ROS based

Who What Why What will a robot army look like? Or more important, how will it behave? These questions are timely ones given the Army general who in January announced to a symposium in Arlington, Virginia, that he had “clear guidance” to explore the replacement of human forces with robot ones.

General Robert Cone, Commander of the Army Training and Doctrine Command, told the audience his team is researching the feasibility of shrinking the size of the brigade combat team from about 4,000 soldiers to 3,000 over the coming years, filling the gap with HUMANOID ROBOTS.

VI. ADVANTAGES

1. It works as like human.as well as it follow the instructions of humans like mobile and remote controlled robot as shown in the figure:

   ![Mobile robot](image1.png) ![Remote-controlled robot](image2.png)

2. Human-shaped robots are infinitely easier to manipulate because there is a one-to-one mapping between man and machine. Instead of shoving around a non-intuitive joystick, slide your hands into gloves that map your fingers to robot fingers thousands of miles away. Now put your human expertise to work, without putting your human butt in danger.

3. Humanoid robots take advantage of human environments and equipment.

4. Humanoid robots are easier to train.

5. Teamwork is easier between humans and humanoids.

6. The locals could potentially interact with humanoid robots.
VII. DISADVANTAGES

Disadvantages are hard to be avoided because with every emerging technology comes a disadvantage you cannot just change things without an effect on something else.

1. Many people are going to lose their jobs, people who become socially introverted.
2. Emotion, Anger resulting into an uprising. It would be a good idea for no humanoid robots. And for all plans in robotics to be destroyed, or else there might be a humanoid robot uprising resulting desaster.
3. Giving a robot too much autonomy introduces the possibility of unexpected behaviors. In the computer world, that’s called a “bug”.

VIII. CONCLUSION

Mind games are a part of every battle. During World War II, aviators painted snarling teeth on the noses of their fighter planes. Nowadays (and back then), bombs have funny messages written on them, like "Boom shacka lacka," and "You want fries with that?"

Now imagine the enemy reaction on Robot D-Day, when thousands of super-powered humanoid robots march out of the crashing surf, bullets plinking harmlessly from their razor-sharp gilded breast-plates as death metal blares from their metal mouth speaker grilles.

Terrified yet? Well calm down, sissy; humanoid robots aren’t on the battlefield, yet. But they might be soon, thanks to their natural ability to communicate and cooperate with humans, the ease with which they can operate in our environments and use our tools, and the terrible fear that blossoms in the heart of man upon laying eyes on the great and horrifying visage of the humanoid robot war machine.

IX. REFERENCES

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