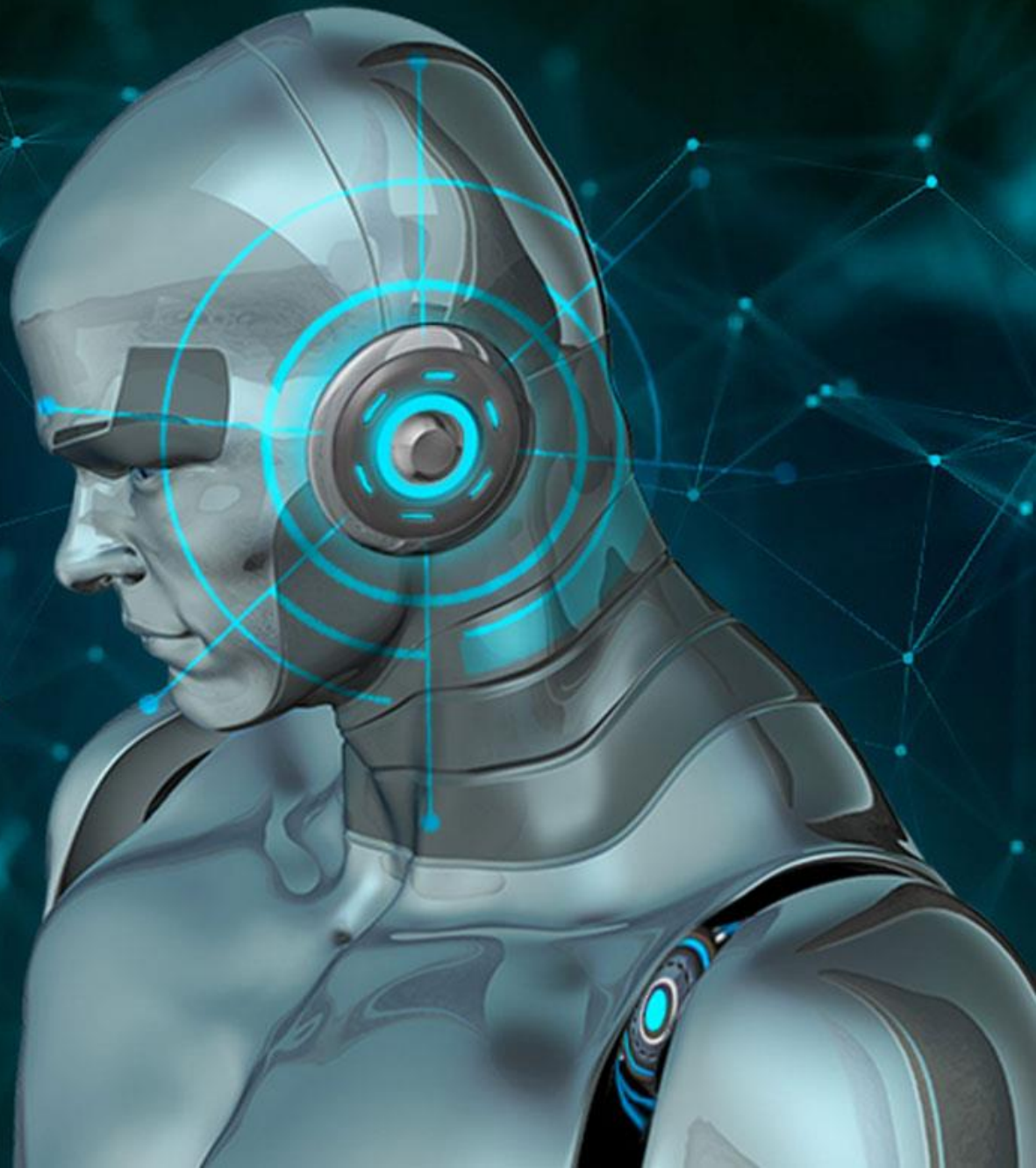
Humanoids



Ruwaa Mohammed Surrati 1806295

Outline

01 Overview

02 Locomotion

03 Manipulation

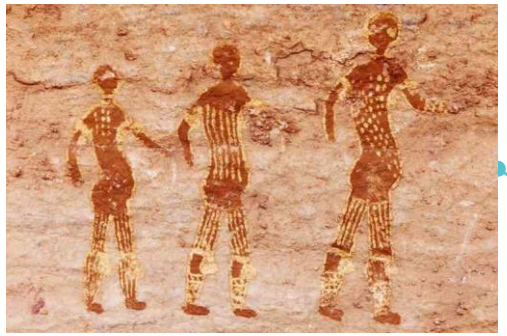
04 Whole-Body Activities

05 Communication

Introduction

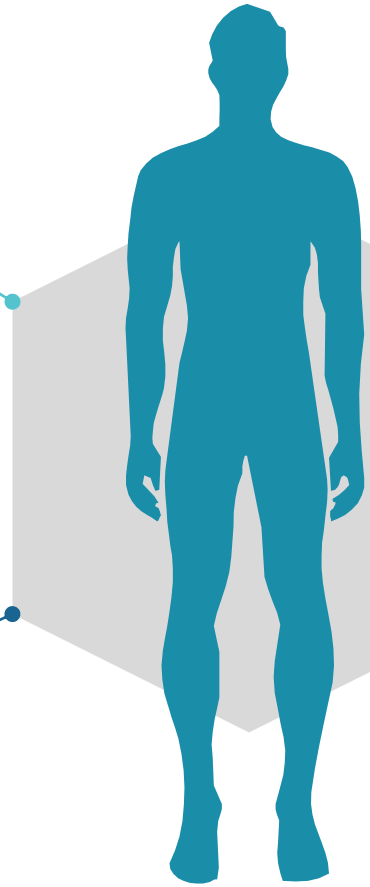
The field of humanoid robotics focuses on the creation of robots that are directly inspired by human capabilities with similar kinematics, sensing and behavior to humans. They are developed as general-purpose mechanical workers, entertainers, and test-beds for theories from neuroscience and experimental psychology.

The Pleasing Mirror



Cave Drawings

Science Fiction



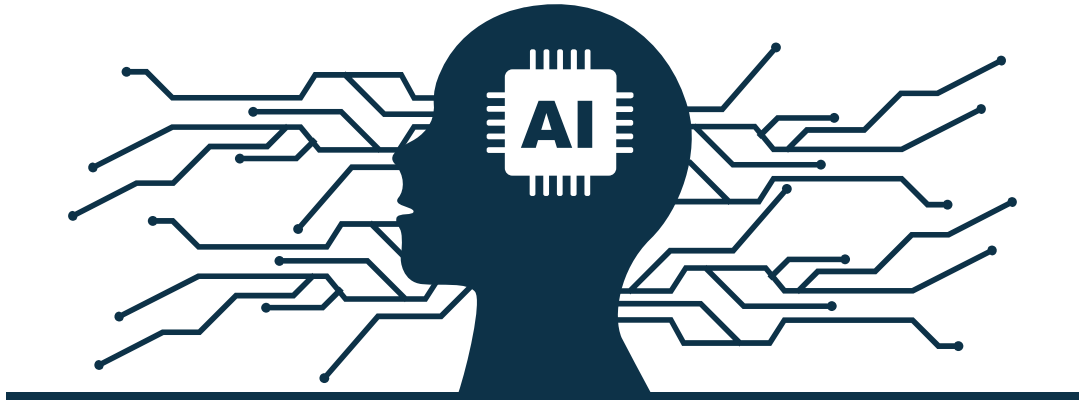
Sculpture

Photographs

Understanding Intelligence

Researchers in the humanoid robotics community see humanoids as a tool with which to better understand humans. Humanoid robots offer an opportunity to test understanding through construction.

Scientists, psychologists, and linguists have found strong links between the human body and human cognition.



Interfacing with the Human World

Robots with legs could potentially traverse the same environments that humans traverse. In addition to mobility advantages, legs can help in other ways, such as changing the posture in order to lean into something, pulling with the weight of the body, or crawling under an obstacle.

Entertainment and Surrogates

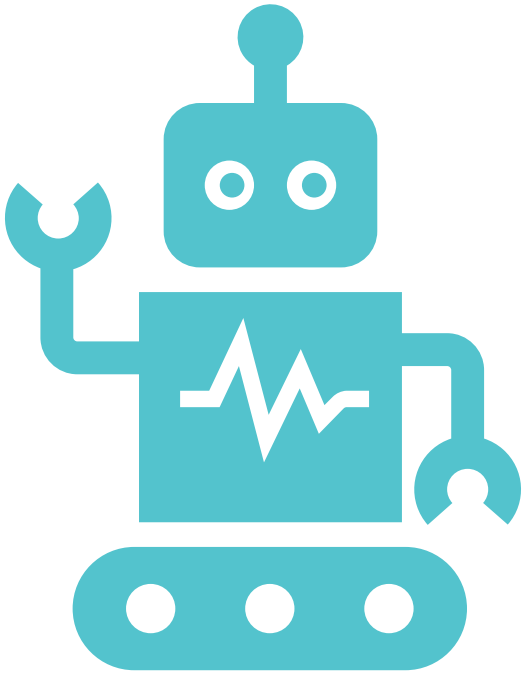
Humanoid robots are inherently appropriate for some applications. For example, many potential forms of entertainment, such as theater, theme parks, and adult companionship, would rely on a robot that closely resembles a human.

Actroid robot is designed for entertainment, telepresence, and media roles.

Different Forms

- head and face
- head with two arms mounted to a torso
- torso with wheels
- expressive face with arms, legs, and a torso

This variation in form impacts the ways in which the robot can be used.



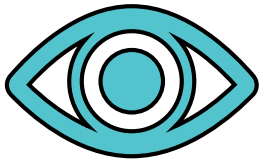
Different DOFs

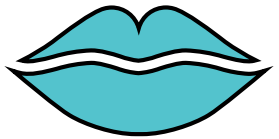
Humanoids often incorporate actuated degrees of freedom in the face to generate facial expressions similar to those that humans can generate with their facial muscles. Likewise, the upper body of humanoid robots usually includes two arms, each with a one-DOF rotary joint at the elbow and a three-DOF rotary joint for the shoulder.

Different Sensors

Humanoids can imitate human sensing by having sensors with clear human analogs mounted on them in a way that mimics the placement of human sensory organs.

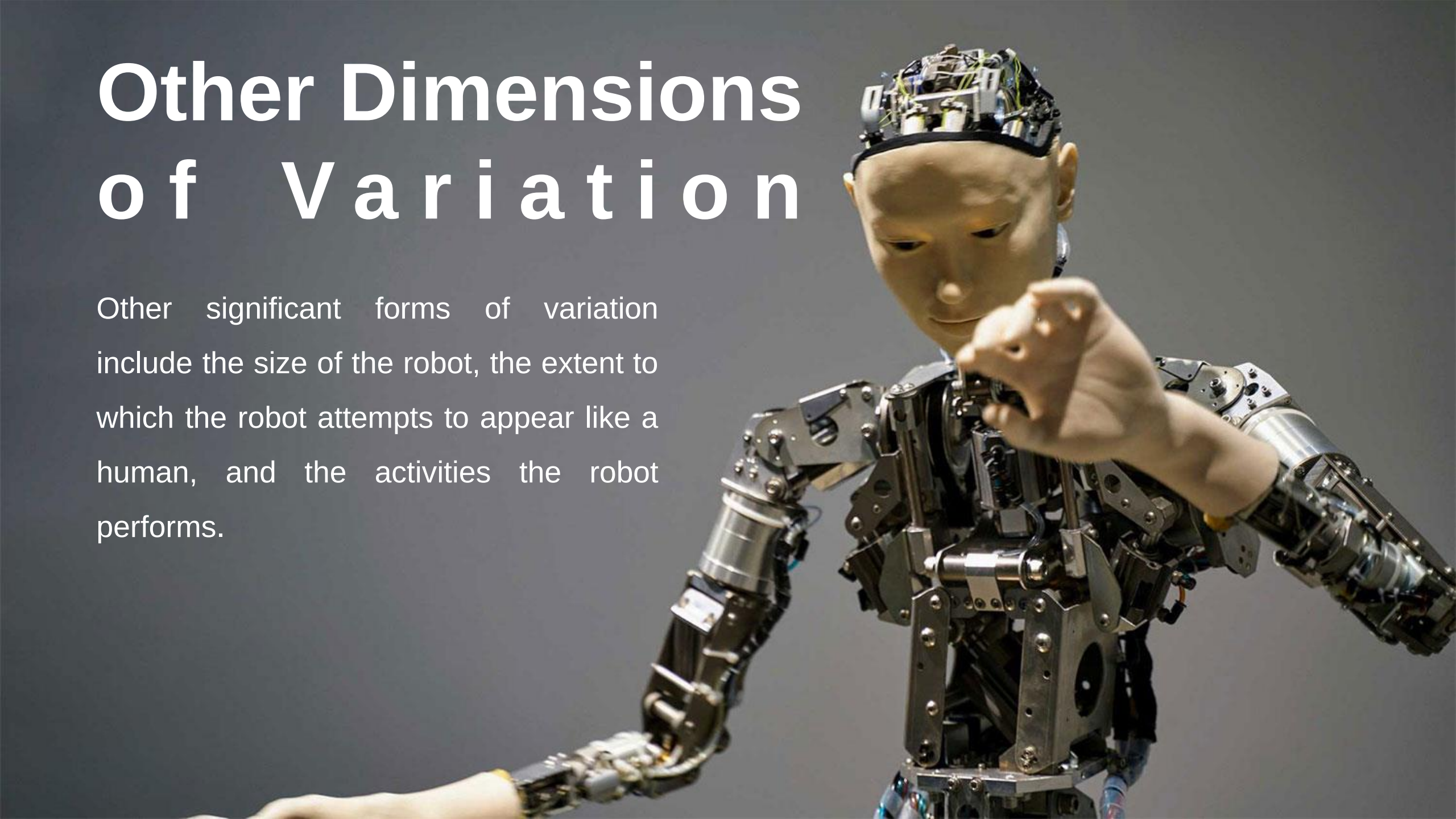
- ❑ Does the robot see the same world that humans see?
- ❑ Additional sensors without human analogs





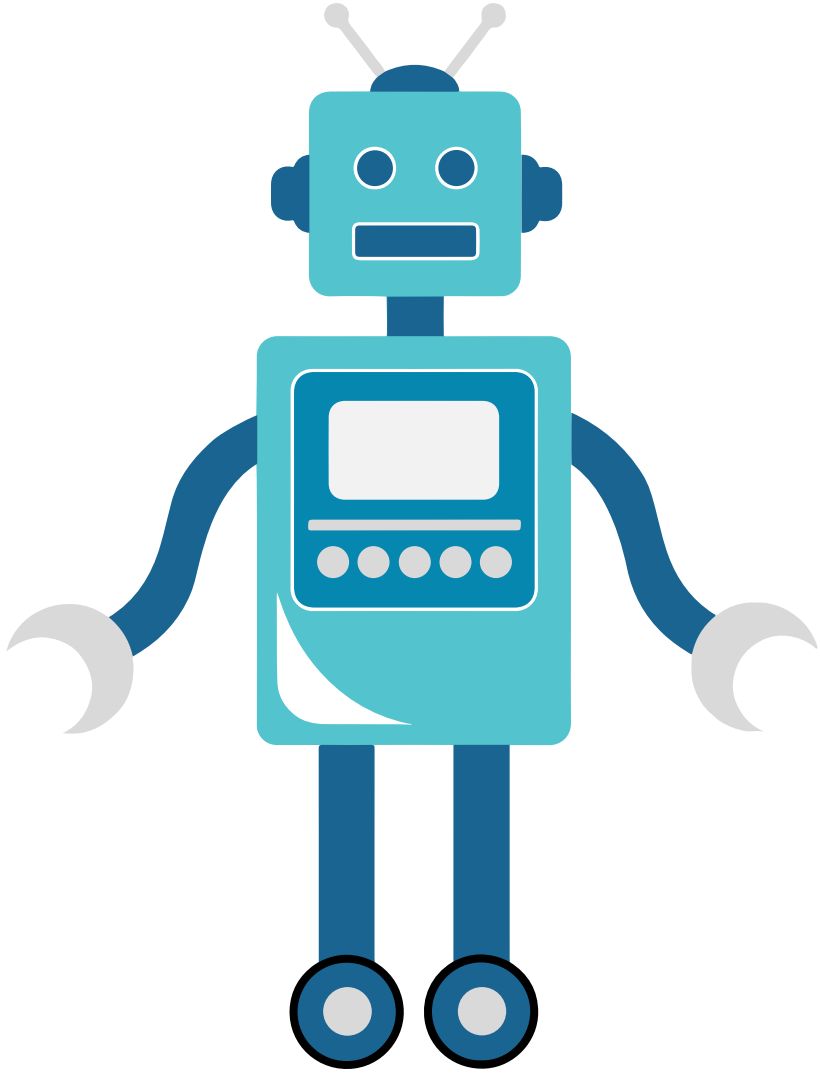
Other Dimensions of Variation

Other significant forms of variation include the size of the robot, the extent to which the robot attempts to appear like a human, and the activities the robot performs.



Locomotion

Bipedal humanoid locomotion is a challenging area of robotics research. Some small bipedal humanoids have stable walks due to their large feet and low center of mass, but large bipedal humanoids might find it difficult to balance due to the human-like weight distribution and body dimensions.



Bipedal Locomotion

https://www.youtube.com/watch?v=MPhEmC6b6XU

Falling Down and Getting Up

https://www.youtube.com/watch?v=3cg9pGMvFJM

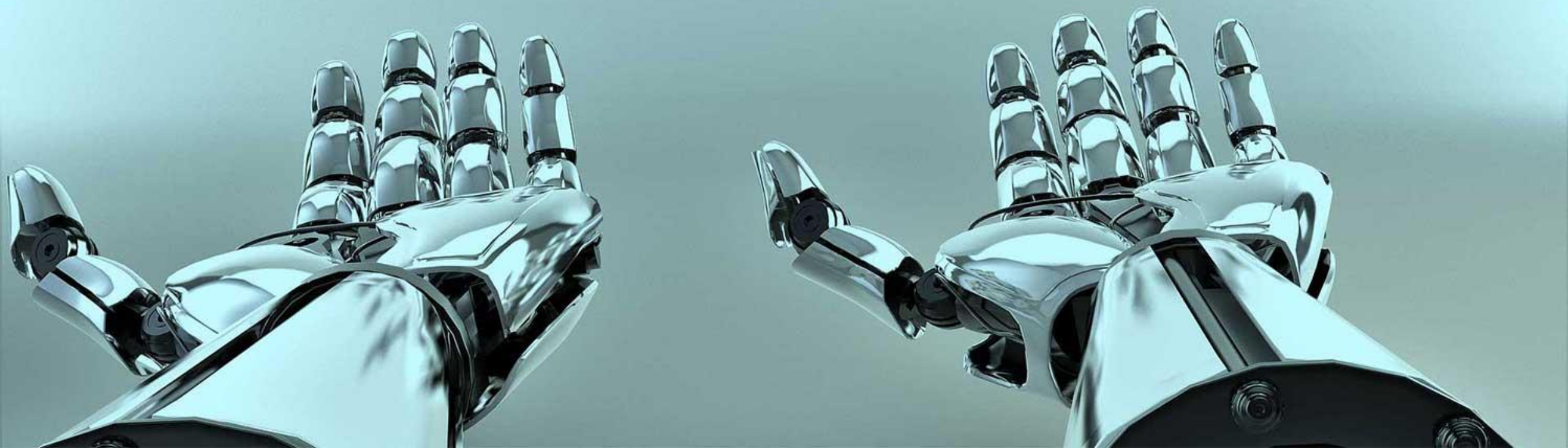
Localization and Obstacle Detection

https://www.youtube.com/watch?v=g2NZ_EasJv0

Bipedal walking needs to be robust to unexpected disturbances encountered during the execution of planned walking patterns.

Manipulation

Manipulation research within humanoid robotics focuses on the use of humanlike arms, hands, and sensors to perform tasks that are commonly performed by people.



Rhythmic Manipulation

Many everyday tasks performed by humans involve rhythmic motions rather than discrete motions.

Rhythmic motion can be used for learning tasks from human demonstration.

https://www.youtube.com/watch?v=S-4vj_S46jY

Cog robot can perform a variety of tasks without motion planning or model-based control.

Learning and Development

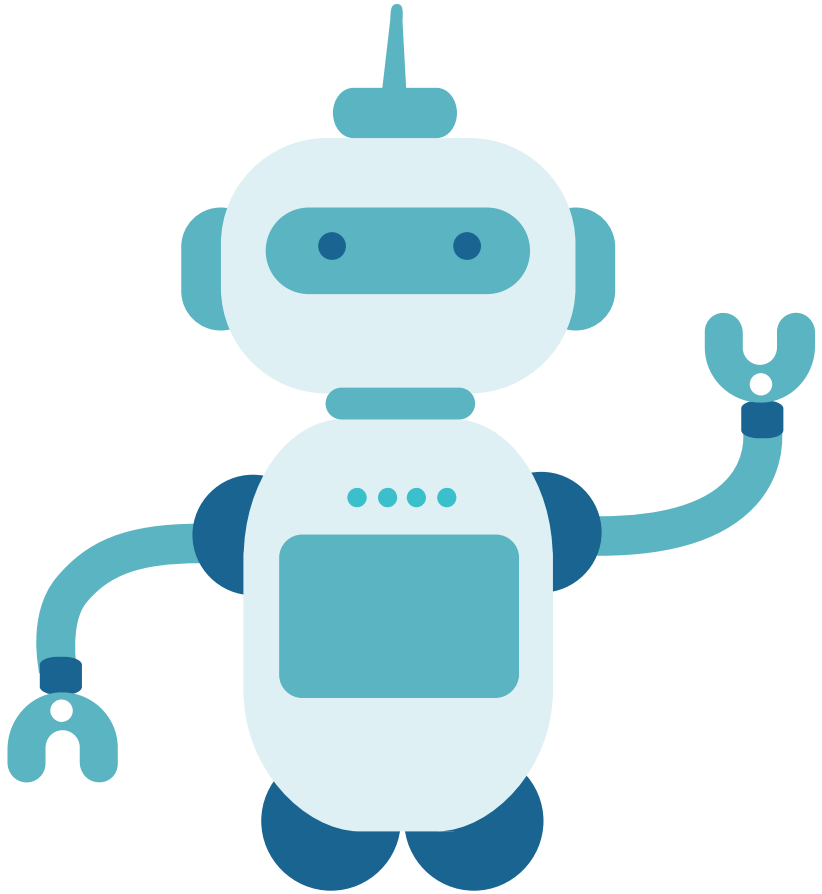
Learning by demonstration is a common way for people to learn from each other. Therefore, it may have advantages for skill acquisition when used in humanoids robots.

DB robot learns to play air hockey against a human opponent through observation and practice.

Whole-Body Activities

Humanoids can perform tasks such as lifting and carrying a box, climbing a ladder, and even playing a sport.

Unlike the industrial robots, or a humanoid that is fixed in place, a bipedal humanoid must be controlled so as to remain balanced while manipulating an object.



Whole-Body Activities

https://www.youtube.com/watch?v=tF4DML7FIWk

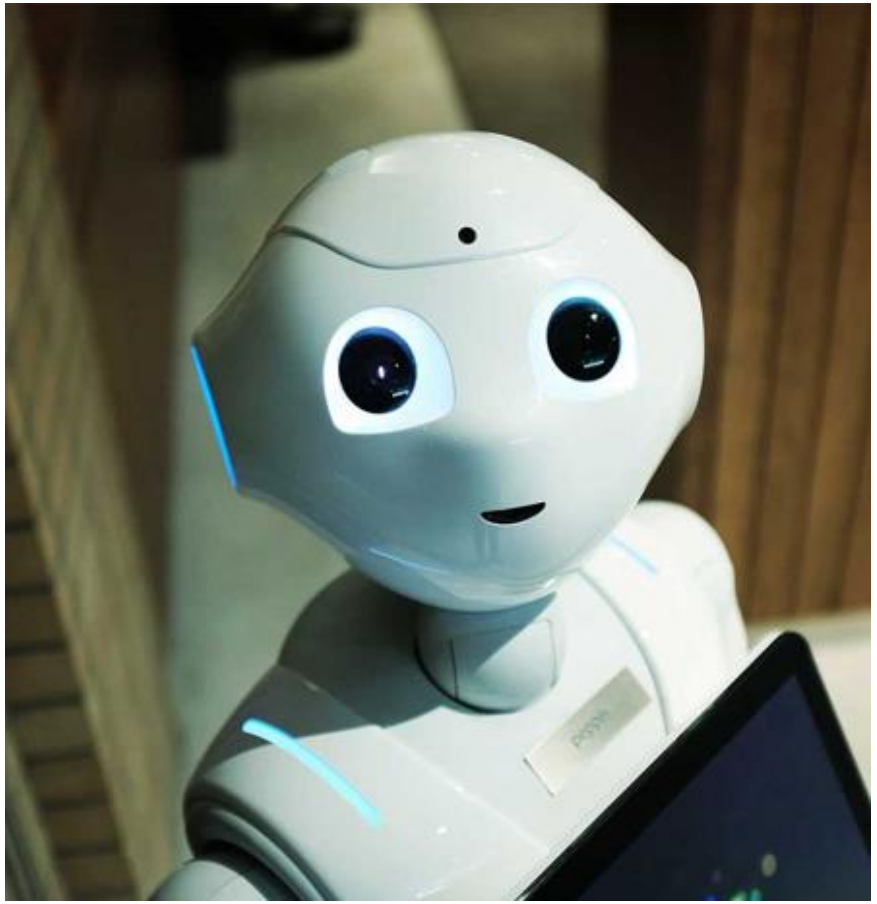
Communication

Humans evaluate each others' state through body posture and movement. It is quite natural to extend this form of communication to include robots that share our morphology.

Expressive Morphology and Behavior

Humanoids integrate communicative and noncommunicative functionality.

- ❑ The hand
  - Grab and lift
  - Wave (hi, goodbye)
- ❑ The head
  - Cameras and microphones
  - Expressive poses



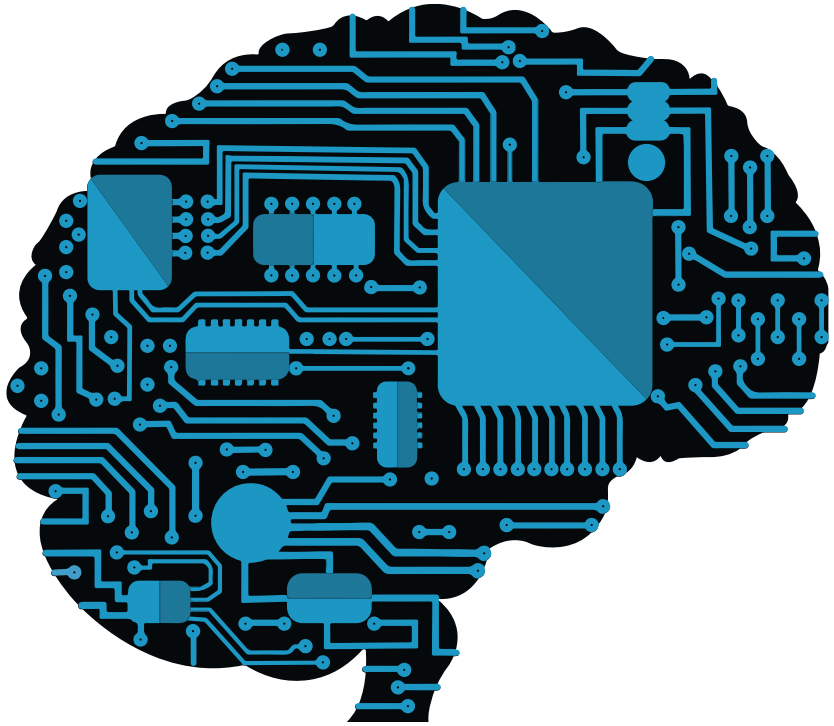
Interpreting Human Expression

https://www.youtube.com/watch?v=Sq36J9pNaEo

Posture and Expression

The recognition and interpretation of the location and pose of humans is important, since humanoids are often expected to work in human environments.

Asimo robot can find and identify a person, then recognize gestures such as bye-bye, come here



Conclusion

Over the last decade, the humanoids research community has grown dramatically. Whether or not humanoids become a dominant form for robots may depend on the extent to which they can compete against specialized robots that are better suited to particular tasks and human labor, which in some ways already meets the ultimate goals of humanoid robotics.

References

- Siciliano, B., Khatib, O. and Kröger, T. eds., 2008. *Springer handbook of robotics* (Vol. 200). Berlin: springer.
- ‘15 Caves and Canyons That Hold the World’s Ancient Art’’, Fodor’sTravel. Available at: https://www.fodors.com/news/photos/amazing-ancient-cave-art-from-around-the-world (Accessed: 1 December 2021).
- Klimek, C. (2015) ‘It's Like It Never Happened: A 'Terminator' Dossier’’, npr, 1 July. Available at: https://www.npr.org/2015/07/01/418600470/its-like-it-never-happened-a-terminator-dossier (Accessed: 1 December 2021).
- (2021) ‘Bust (sculpture)’’, Wikipedia, 12 November. Available at: https://en.wikipedia.org/wiki/Bust_(sculpture) (Accessed: 1 December 2021).
- Werner, P. (2021) ‘Immervision and Hanson Robotics announce robot JOYCE with ‘human-like vision’’, *RockingRobots*, 29 March. Available at: https://www.rockingrobots.com/immervision-and-hanson-robotics-announce-robot-joyce-with-human-like-vision/ (Accessed: 30 November 2021).
- Dynamic Robotics Laboratory. (2021) Robot Learns to Climb Stairs Blind. 19 May. Available at: https://www.youtube.com/watch?v=MPhEmC6b6XU (Accessed: 29 November 2021).
- cjmichaels. (2012) Sorry, I slipped!!! Nao during his Tai Chi routine falls and appologises. 10 October. Available at: https://www.youtube.com/watch?v=3cg9pGMvFJM (Accessed: 29 November 2021).
- HumanoidsBonn. (2013) Nao humanoid autonomously stepping over and onto obstacles with 3D sensing. 31 July. Available at: https://www.youtube.com/watch?v=g2NZ_EasJv0 (Accessed: 30 November 2021).
- Arsenio, A. (2012) Last achievements of the Humanoid Robot Cog at MIT. 27 January. Available at: https://www.youtube.com/watch?v=S-4vj_S46jY (Accessed: 30 November 2021).
- Boston Dynamics. (2021) Atlas | Partners in Parkour. 17 August. Available at: https://www.youtube.com/watch?v=tF4DML7FIWk (Accessed: 30 November 2021).
- Robbins, T. (2020) Meet Sophia, World's First AI Humanoid Robot | Tony Robbins. 17 January. Available at: https://www.youtube.com/watch?v=Sq36J9pNaEo (Accessed: 29 November 2021).


THANK YOU
Any questions?