Humanoid Robots : ASIMO

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- Why Humanoid Robots?
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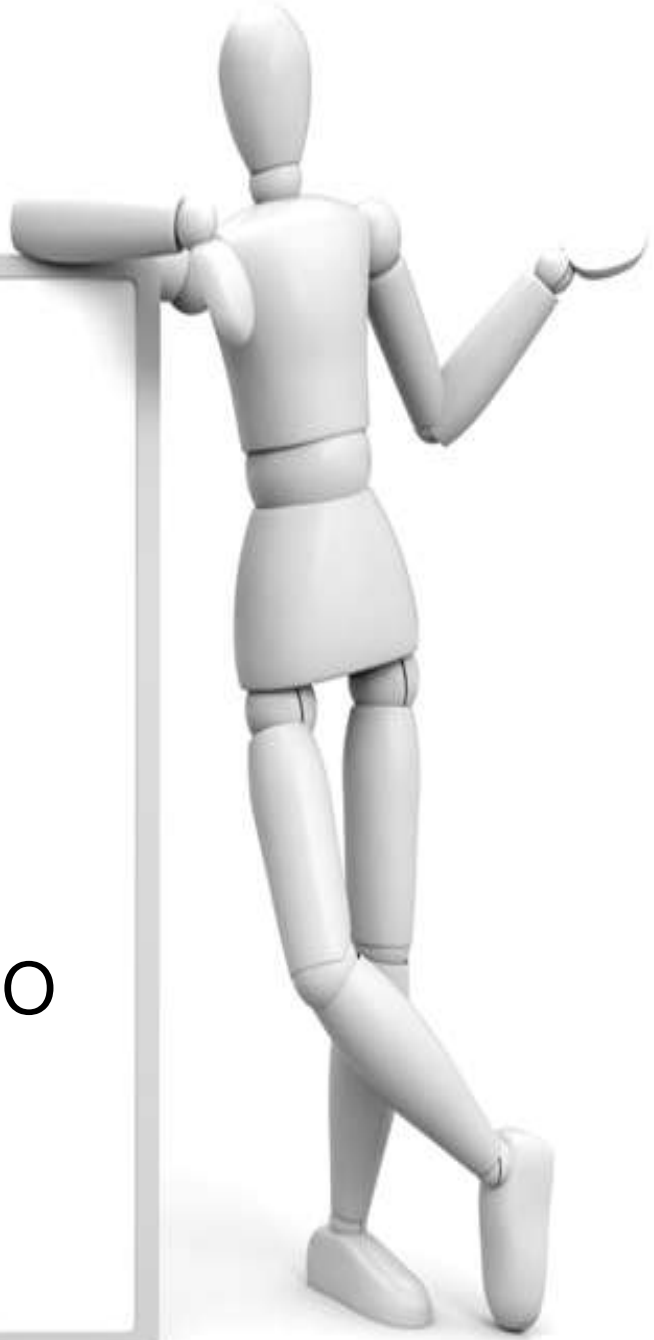
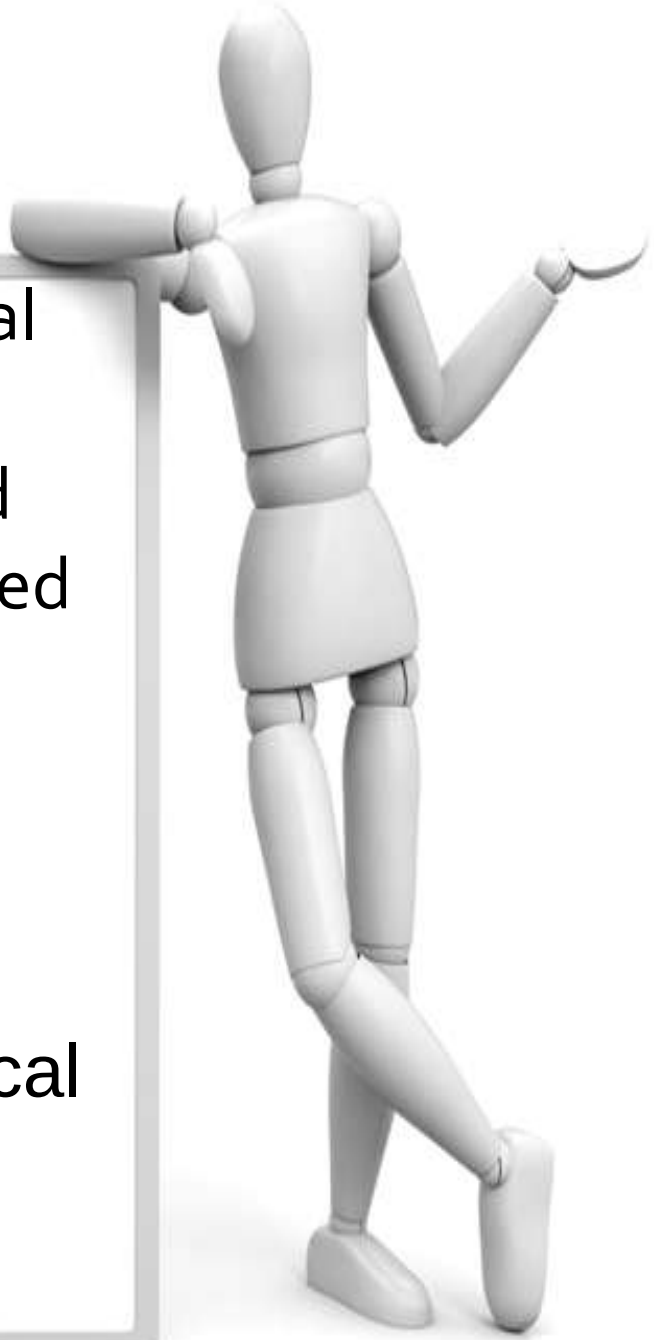


What is Robot??

- "A reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through various programmed motions for the performance of a variety of tasks."

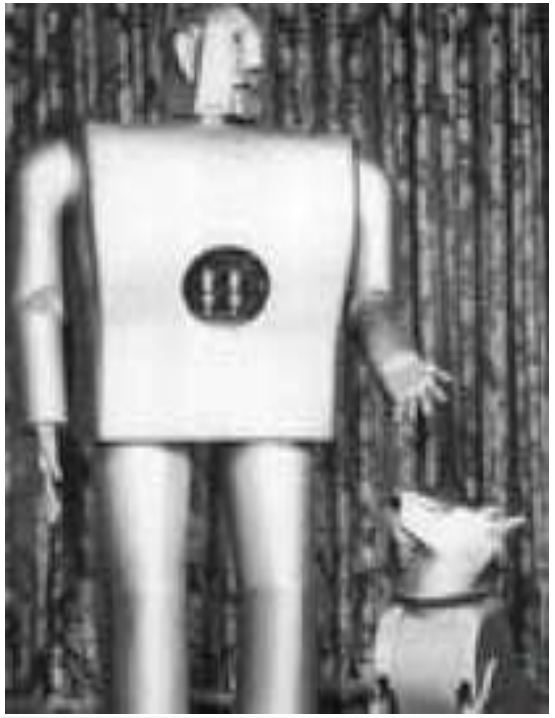
  - *Robot Institute of America, 1979*

- An Intelligent robot is a mechanical creature which can function autonomously"



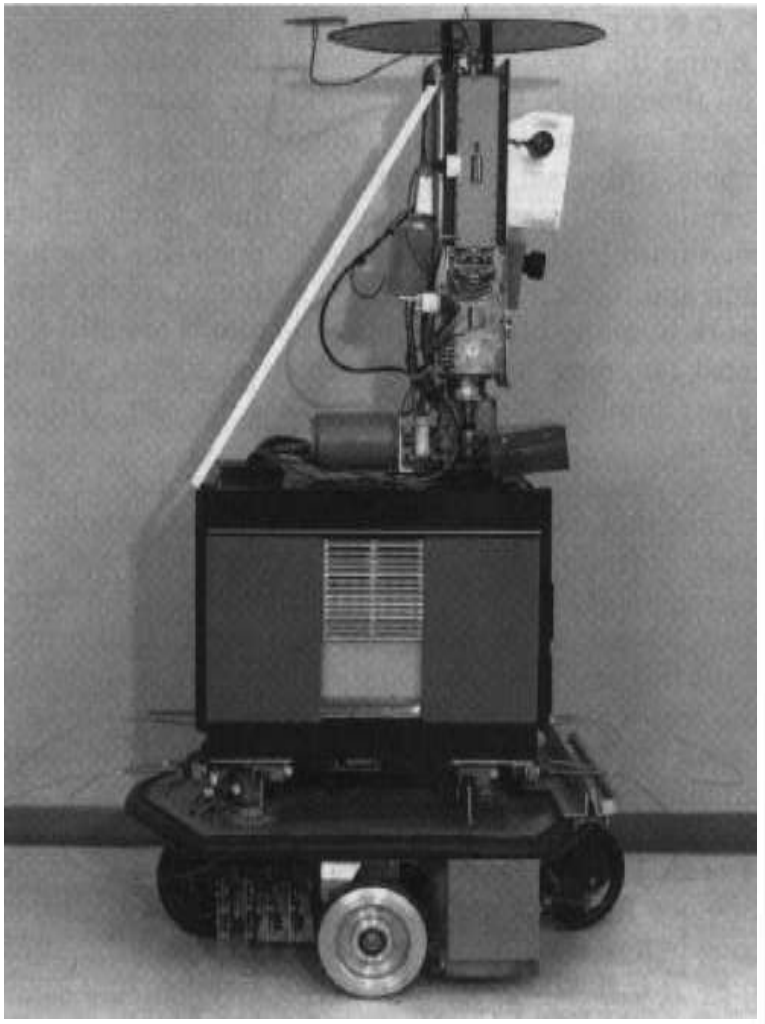
History

- Early Stages
  - The notion of **putting machines to work can b**e credited to great thinkers like **Aristotle.**
- Westinghouse Electric Corp. creates two of the **first robots that use the electric motor for entire body motion.**



History (cont.)

- 1968…'Shakey' build at Stanford Research Institute.
- Shakey could perform tasks that required planning, route-finding, and the rearranging of simple objects.

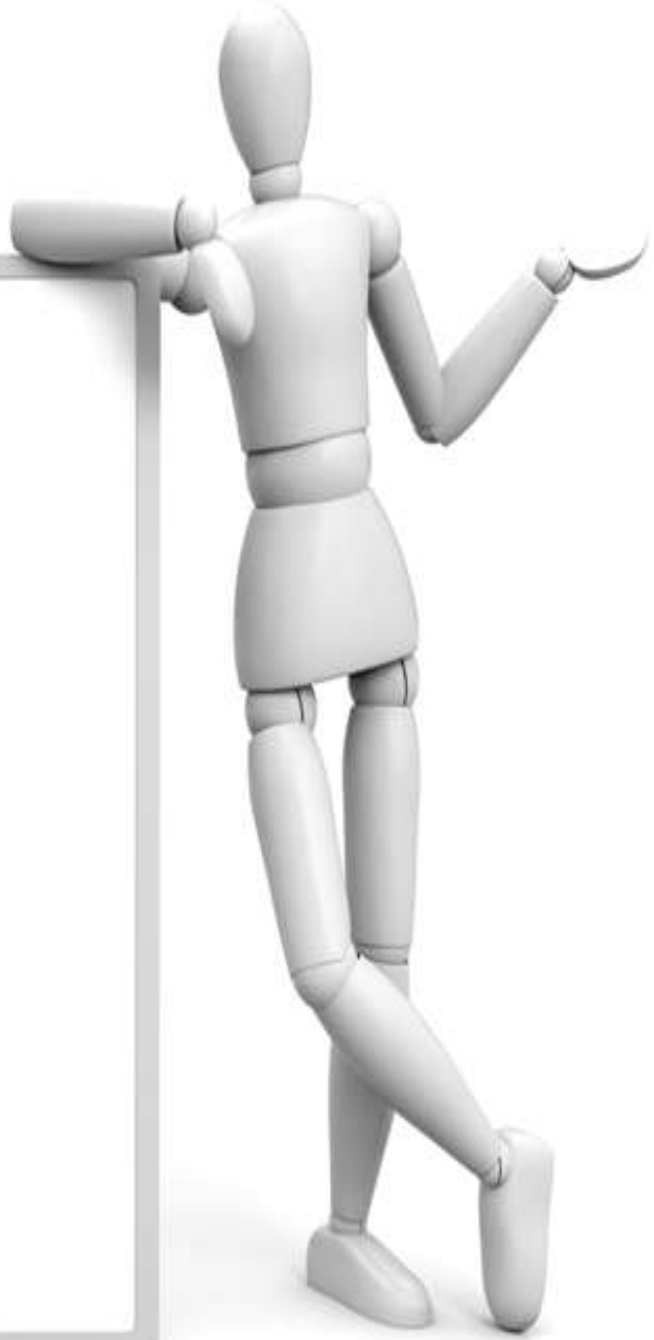


Our Times

- In 1997 the P1 robot was produced by Honda which was more human like.
- Capabilities:-
  - Walk around
  - Climb stairs
  - Carry things
  - Pick things up
  - Push things
  - Position it self accurately

Our Times (cont.)

- In 2000 Honda incorporated the P3 technology into its dancing robot ASIMO.

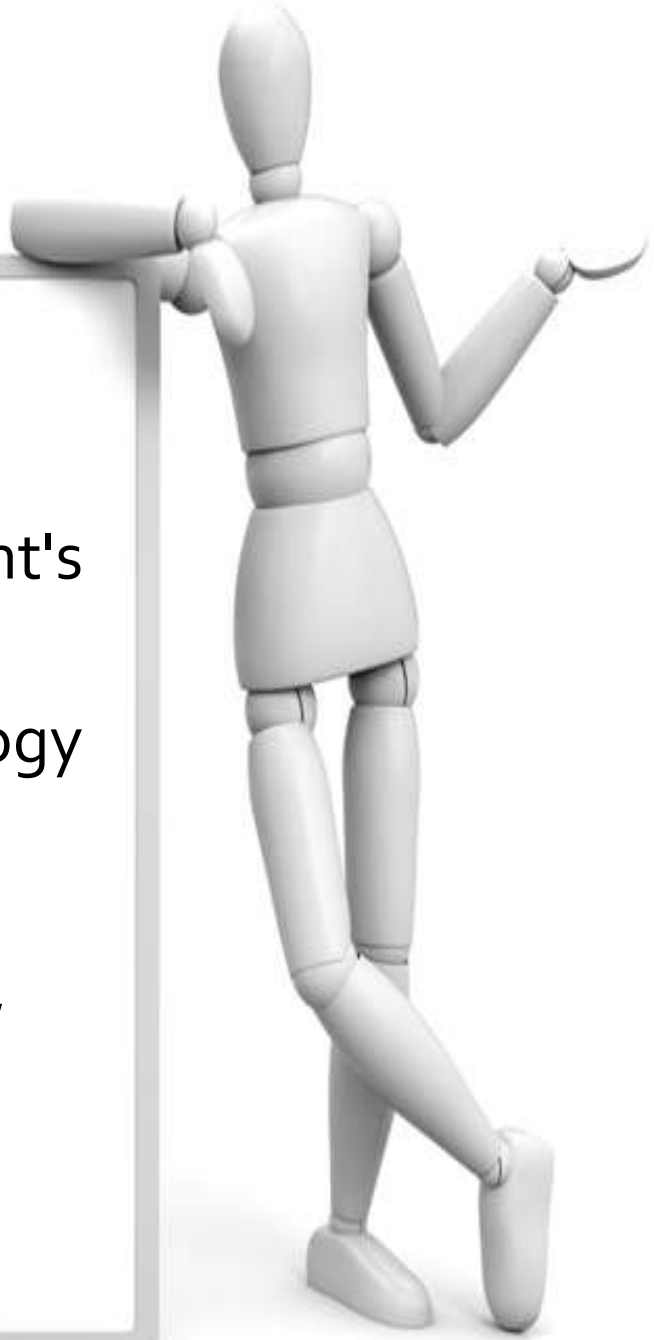


Why Humanoids??

- Are there any good reasons for doing research on humanoid robots?
  - Work in dangerous environments
  - Exhaustive and repetitive tasks.
  - Division of labor with humans in cooperative tasks
  - Anthropomorphism
  - Embodiment
  - Interaction and Communication

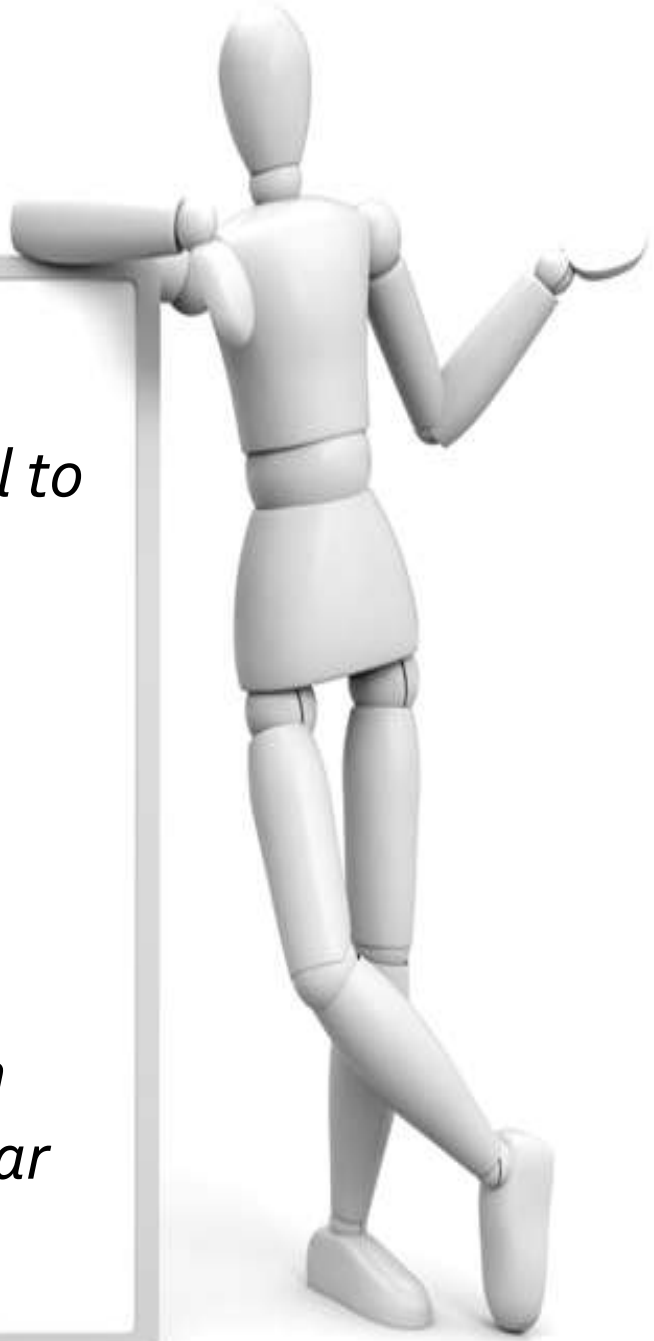
Why Humanoids??

- Anthropomorphism
  - Humans have built complex environments, tools and equipment's very much adapted to our selves.
  - Robots with human-like morphology and motion capabilities have a greater potential acting in living environments created for humans, than e.g. wheeled robots.



Why Humanoids??

- Embodiment
  - The form of our *bodies is critical to the* representations that we develop and use for both our internal thought and our language.
  - If we are to build a robot with human like intelligence then it must have a human like *body in order to be able to develop similar* sorts of representations.



Why Humanoids??

- Important aspects of being human are *interaction and communication with other* humans.
  - Humanoids can *communicate in a manner that* supports the natural communication modalities of humans. Examples include: facial expression, body posture, gesture, gaze direction, and voice.
  - If a robot has humanoid form, then it will be both easy and natural for humans to *interact with it in a humanlike* way.

Who is ASIMO?

- ASIMO is a humanoid robot created in 2000 by Honda.
- ASIMO stands for
  - Advanced Step in Innovative Mobility
- 11th in line of successive bipedal humanoid model's by Honda.
- It is the 4th man like humanoid robot

Specifications

Weight: 52 kilograms

Running Speed: 6 km/h

Walking speed: 2.7 km/h

Walking speed while carrying objects: 1.6 km/h

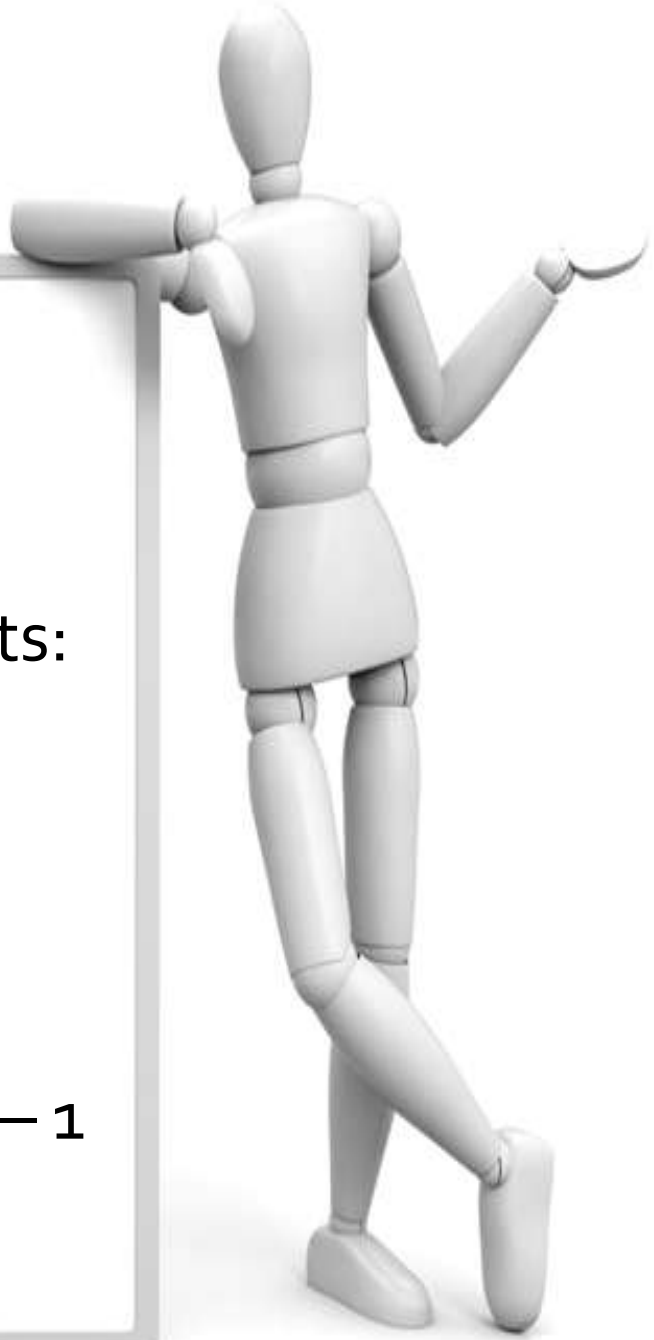
Height: 130 cm

Width: 45 cm

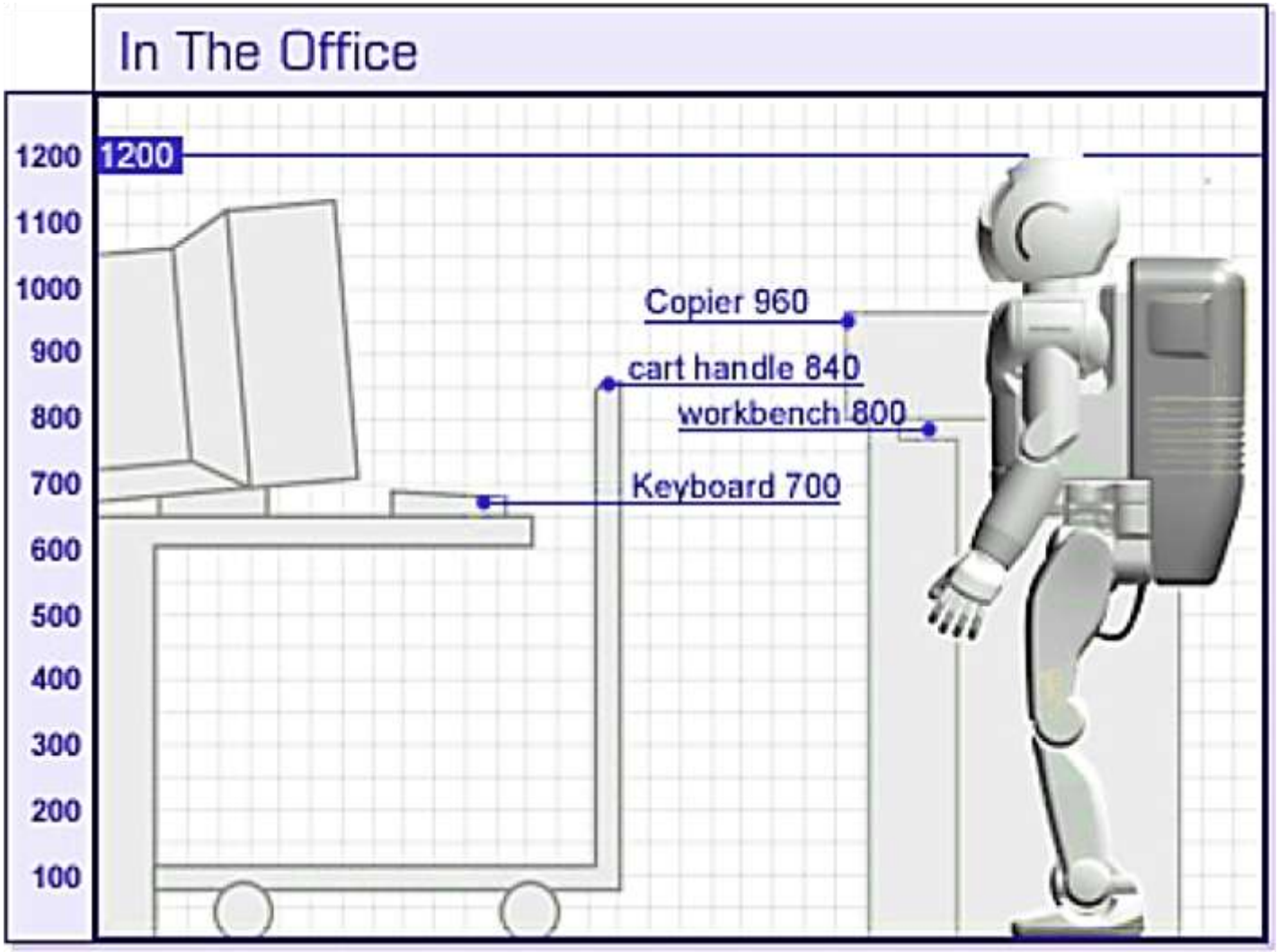
Depth: 44 cm

Continuous operating time: 40 min – 1 hr.

Degrees of Freedom: 34



Why was ASIMO created?



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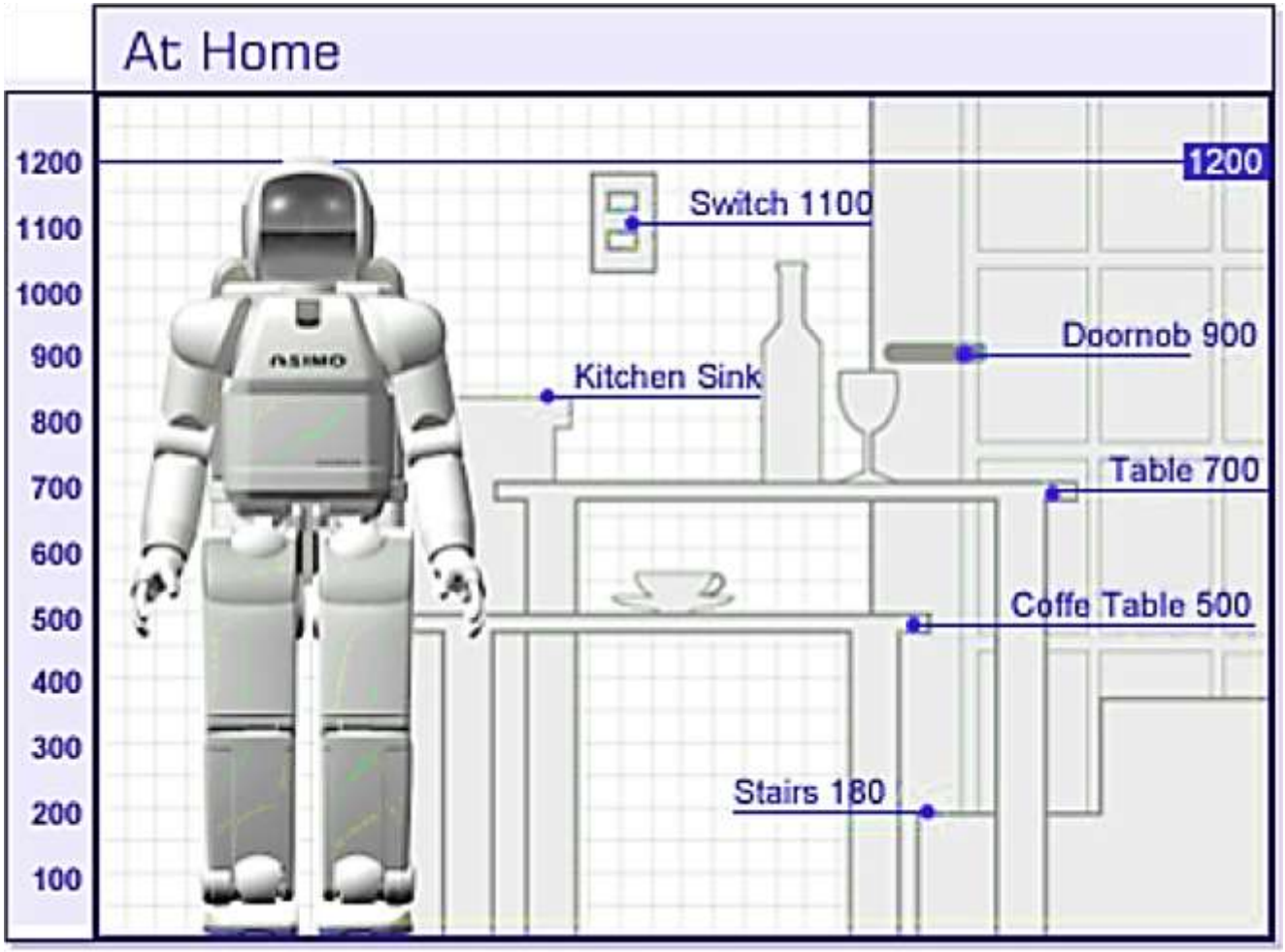


Why Legs for Humanoids ?

- Potentially less weight
- Better handling of rough terrains
- Only about a half of the world's land mass is accessible by current man built vehicles
- Do less damage to terrains (environmentally conscious)
- More energy-efficient
- Use of isolated footholds that optimize support and traction (i.e. ladder)
- Active suspension
- Decouples the path of body from the path of feet
- Exploit discrete footholds

Why Bipeds?

- Why 2 legs? 4 or 6 legs give more stability, don't they?
- A biped robot body can be made shorter along the walking direction and can turn around in small areas
- Light weight
- More efficient due to less number of actuators needed
- Everything around us is built to be comfortable for use by human form
- Social interaction with robots and our perception
- Our instinctive desire to create a replica of ourselves

Walking vs. Running

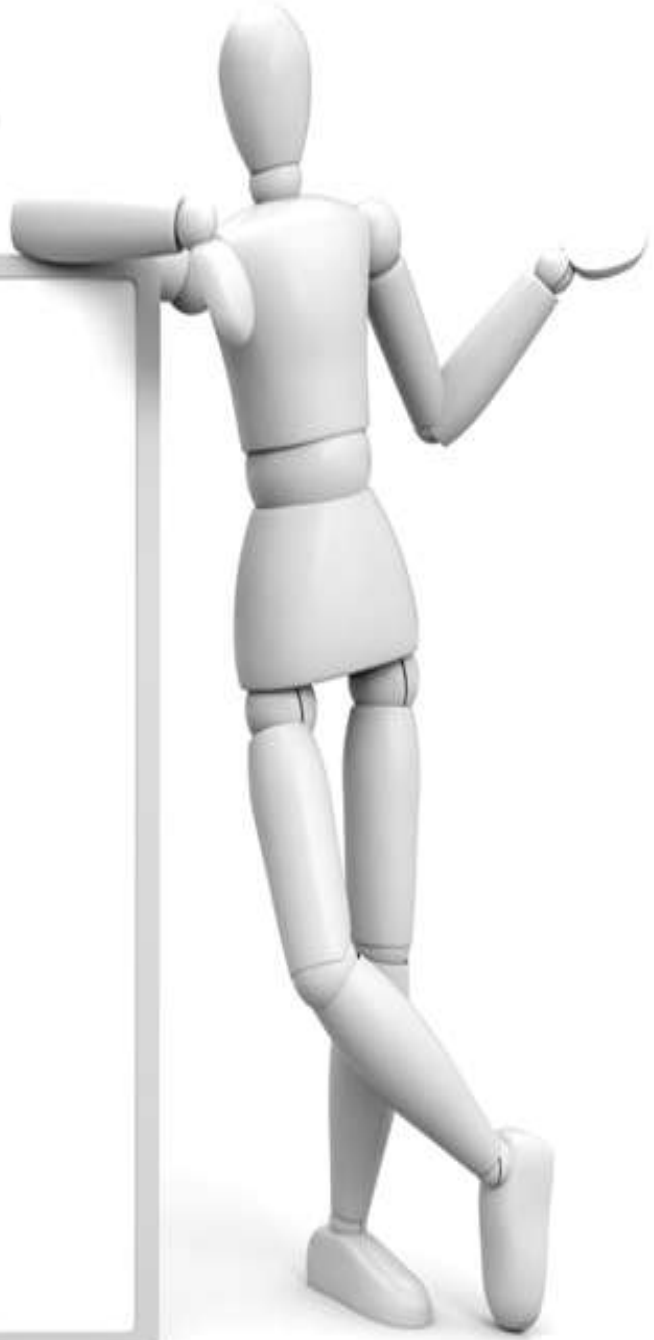
- Motion of a legged system is called walking if in all instances at least one leg is supporting the body
- If there are instances where no legs are on the ground, it is called running
- Walking can be statically or dynamically stable
- Running is always dynamically stable
- Airborne time for ASIMO 0.08 sec.

Honda's Dynamic Stability Controller

- Keep foot flat on the ground (fully actuated)
- Estimate danger of foot roll by measuring ground reaction forces
- Carefully design desired trajectories via optimization
- Keep knees bent (avoid singularity)
- Adaptive trajectory tracking control (high feedback gains)

Walking - further challenges

- Can't compete with humans in terms of:
  - Speed (0.44 m/s top speed)
  - Efficiency (uses roughly 20x as much energy per unit weight, per distance moved)
- Robustness (Cant perform fast actions as humans)
- DC electric motor runs Hot



Recognition Technology

- With 2000's ASIMO model Honda added many features, labeled "Intelligence Technology", that enable ASIMO to interact better with humans. These features fall under 5 categories:

  1. Recognition of moving objects
  2. Posture/gesture recognition
  3. Environment recognition
  4. Sound recognition
  5. Face recognition.

Recognition of moving objects

- ASIMO can detect movement of multiple objects, assessing distance and direction using the visual info. captured by the camera.
- Featured served by this application are
  - Follow the movements of people
  - Follow a person
  - Yield to pedestrians in its path.
  - Greet a person when he or she approaches

Recognition of postures and gestures

- Positioning and movement of a hand, recognizing postures and gestures.
- Can react and be directed to both voice commands and natural movements of human being.
  - Recognize when a handshake is offered.
  - A person waving at it.
  - Movement directions.

Environment recognition

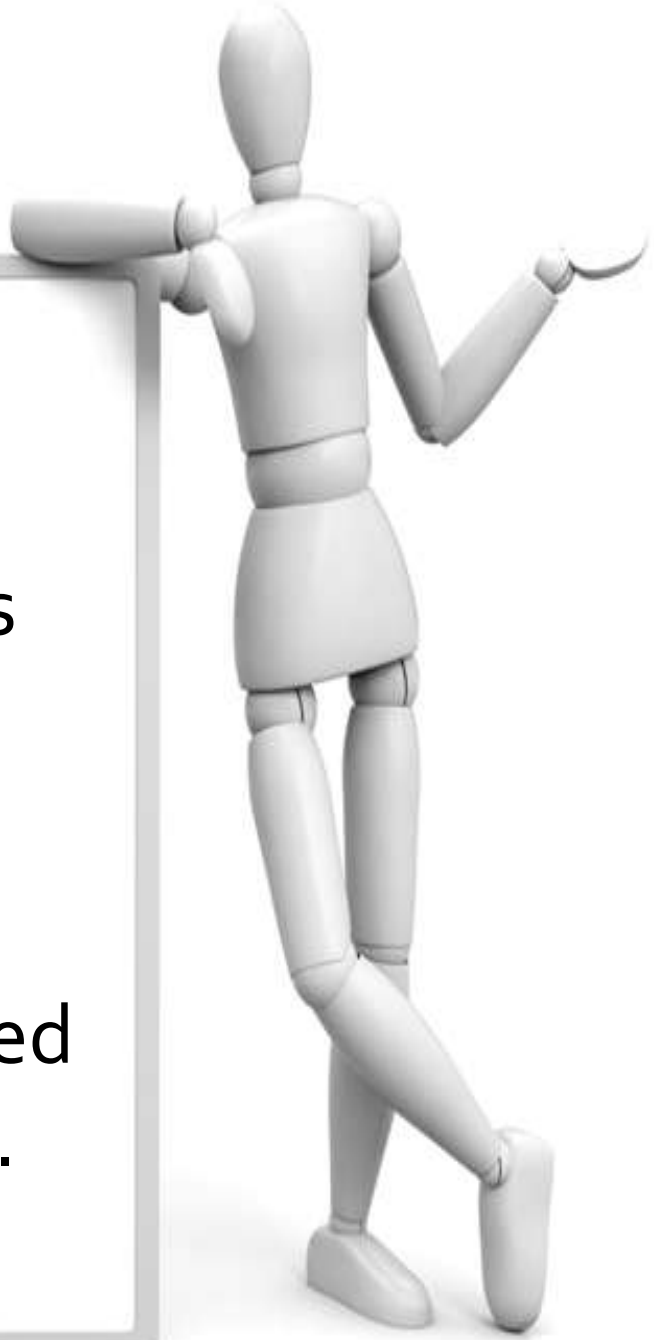
- ASIMO can recognize the objects and terrain of his environment and act in a way that is safe for both himself and nearby humans.
  - Recognizing potential hazards such as stairs.
  - Avoid hitting humans and other moving objects.

Distinguishing sounds

- ASIMO can distinguish between voices and other sounds.
- He can respond to his name, face people when being spoken to, and recognize sudden, unusual sounds such as that of a falling object or a collision, and face in that direction.

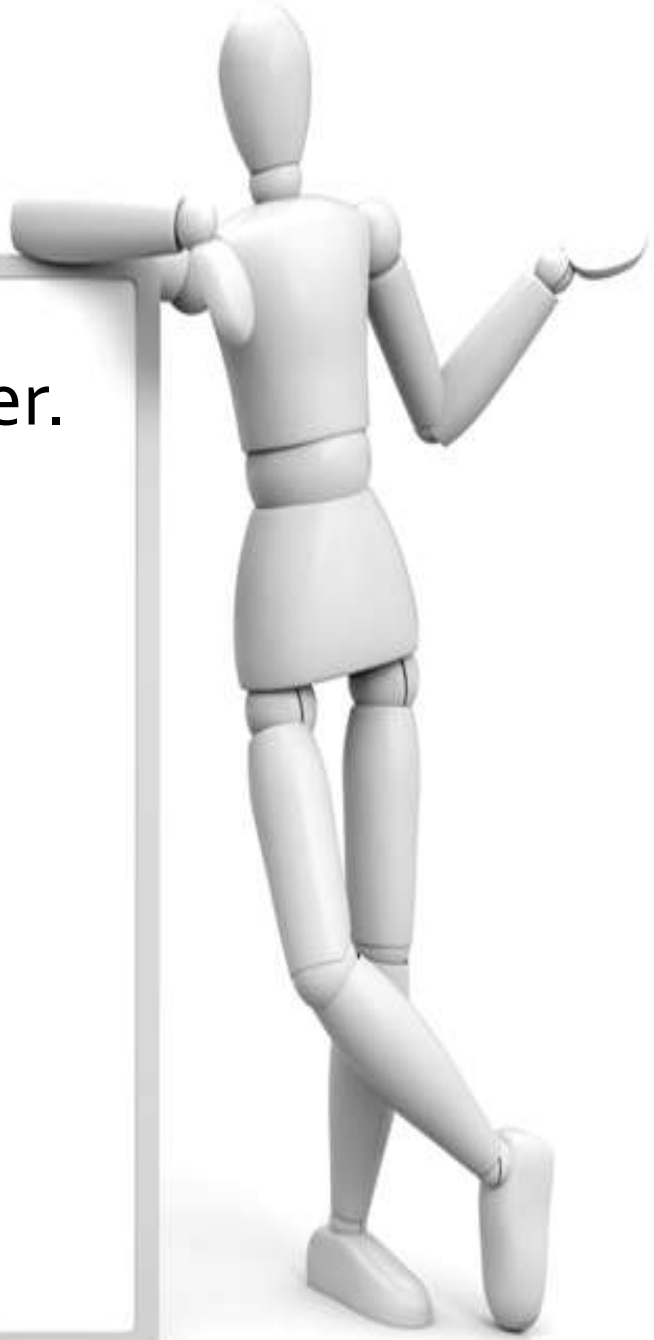
Facial recognition

- ASIMO has the ability to recognize faces, even when ASIMO or the human being is moving.
- It can individually recognize approximately 10 different faces. Once they are registered it can address them by name.



Demo

- ASIMO working as a Bartender.



Conclusion

- Robots are taking over tasks which are deemed dull, dirty and dangerous
- The idea of robots with greater intelligence than humans is at least 50 years away, and may never come
- It's not the robots we need to worry about; it's the people who program them.
- Humanoids can be used as workers at Exhaustive task.

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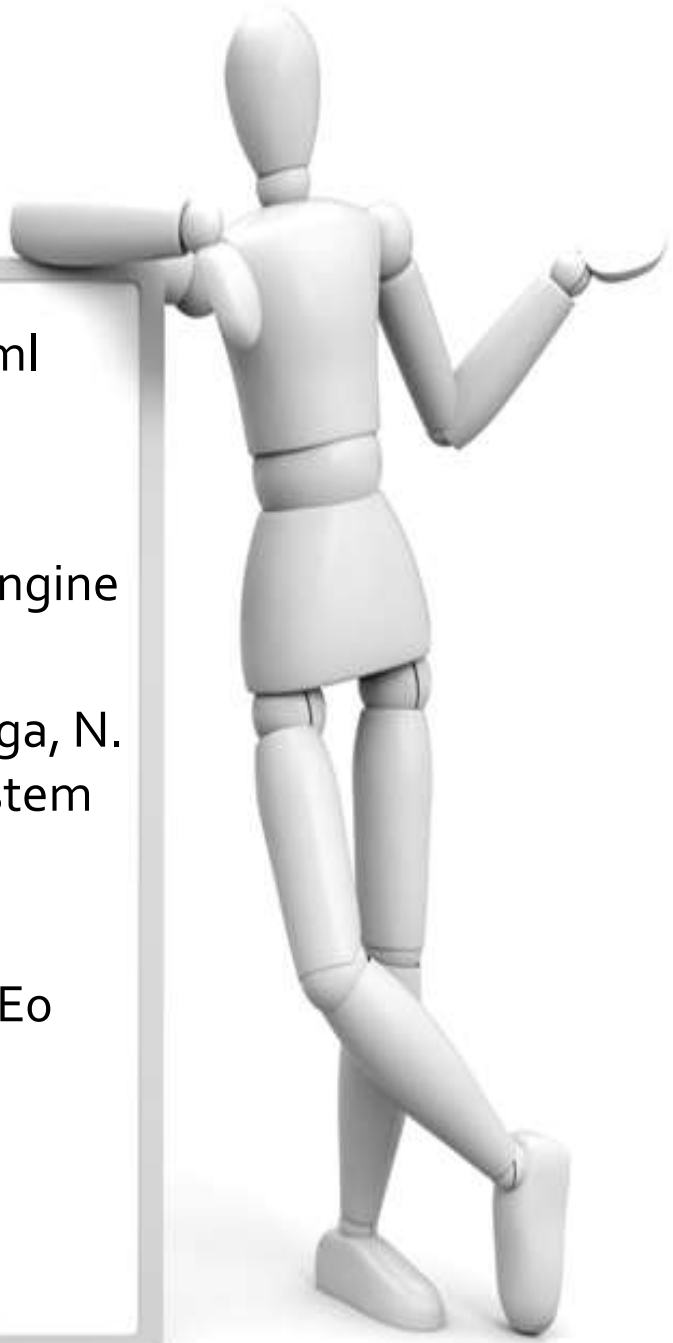

Thank you!!