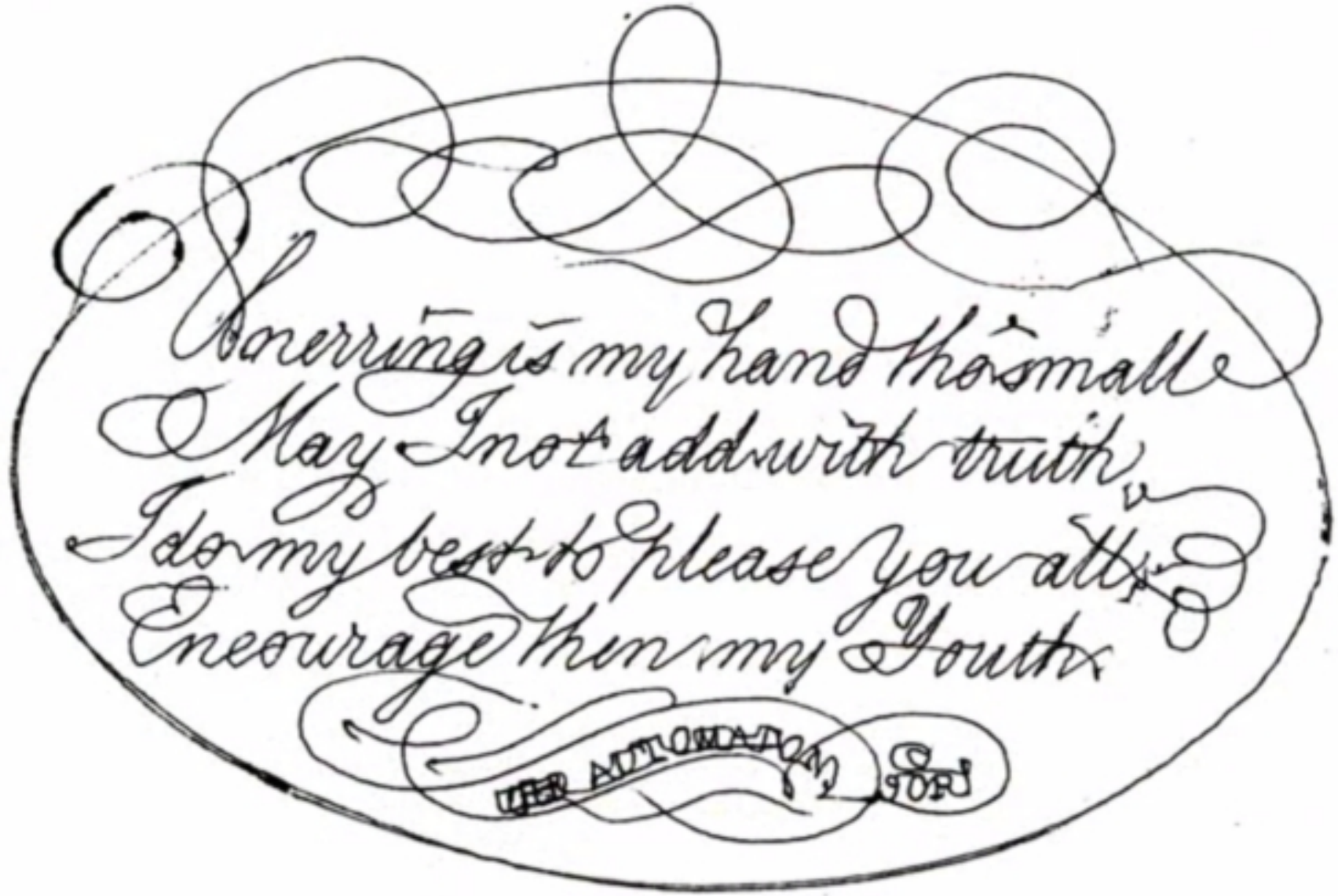
Robotics

- What is a Robot?
- Mechanical automata were created as far back as 17th century Japan
- Maillardet’s automaton, c. 1800. Mechanical, memory, stored four drawings, three poems
- The Mechanical Monk, c. 1560
- Jaquet-Droz’s Automatons
- Grey Walter’s turtles (Machina Speculatrix)


Soe erring is my hand tho small
May I not add with truth
I do my best to please you all
Encourage then my Youth
THE AUTOMATON

Robotics

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Source: New York Times

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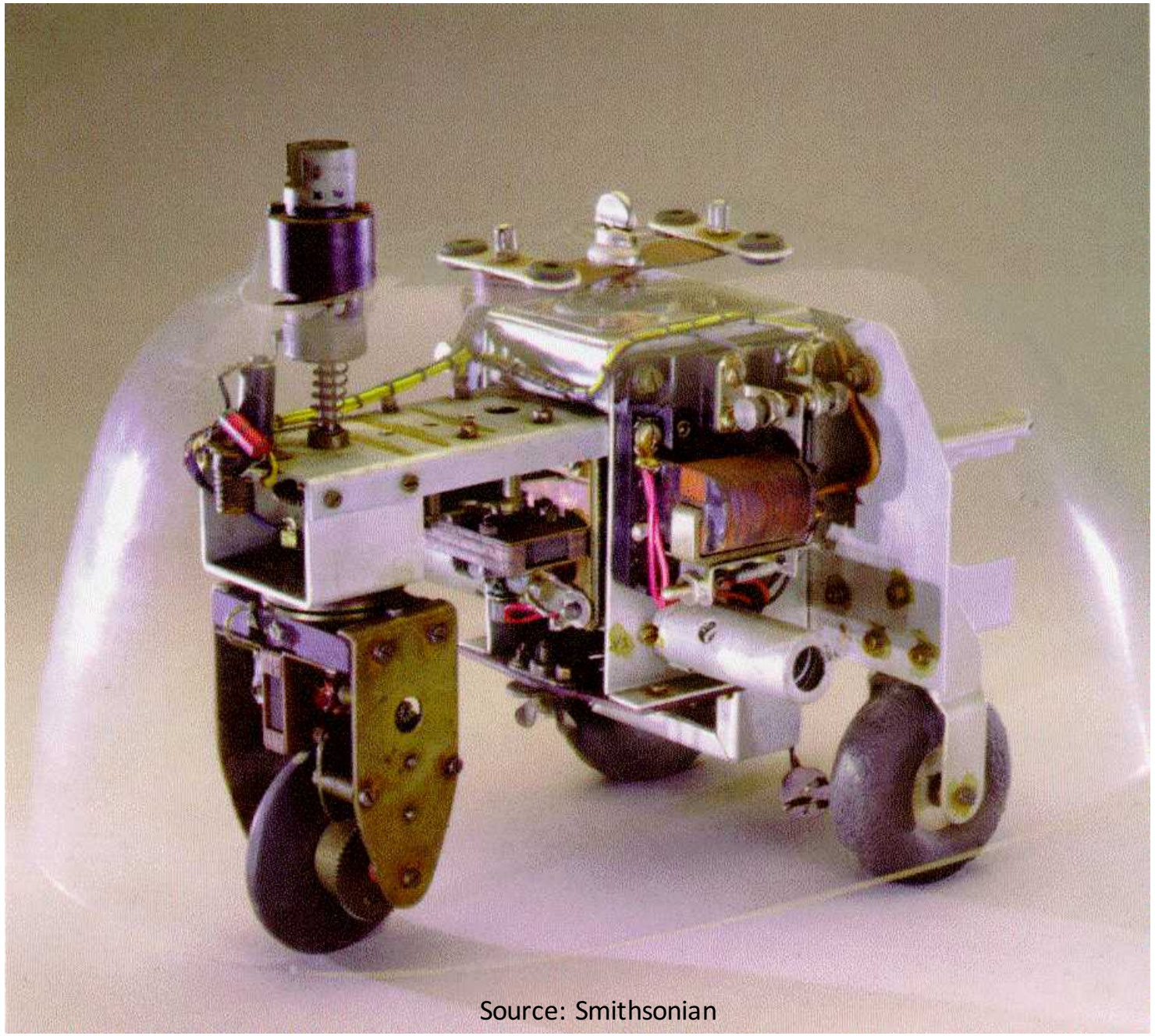


Source: Smithsonian

Robotics

- We have already discussed the issues of design in robotics
- In order for robots to be accepted by humans, they must appear either semi-human, or non-human
- If they appear too human, there is a repulsion
- If non-human, we notice their humanity
- If too human, we notice their non-humanity

Robotics

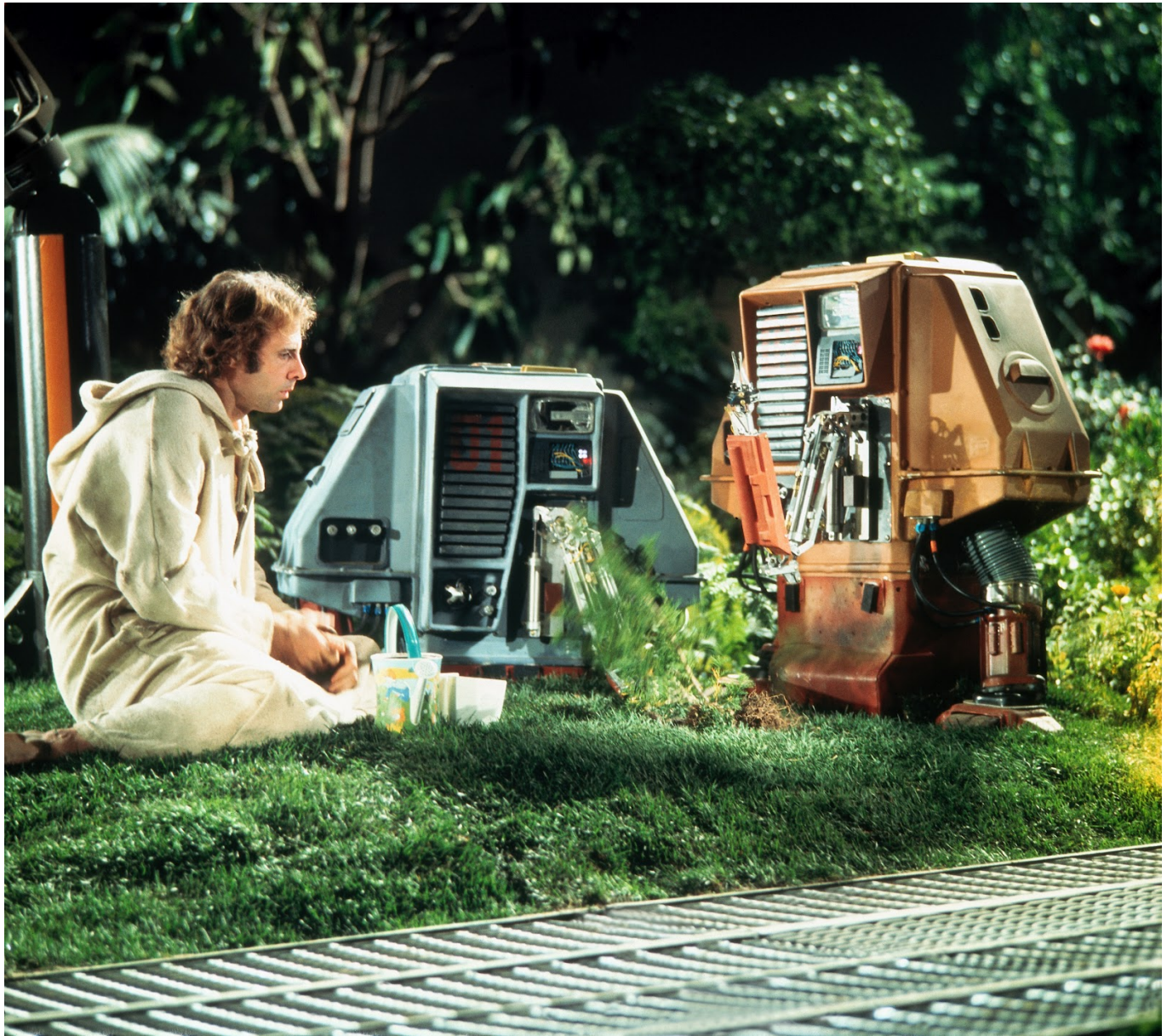
- The Uncanny Valley
  - Coined by Japanese roboticist Masahiro Mori in 1980
  - Serves as a guide for the design of robots
  - Even true for robots in movies
  - The Uncanny Valley can be broached with some animation

Robotics

Robotics

Robotics

Robotics



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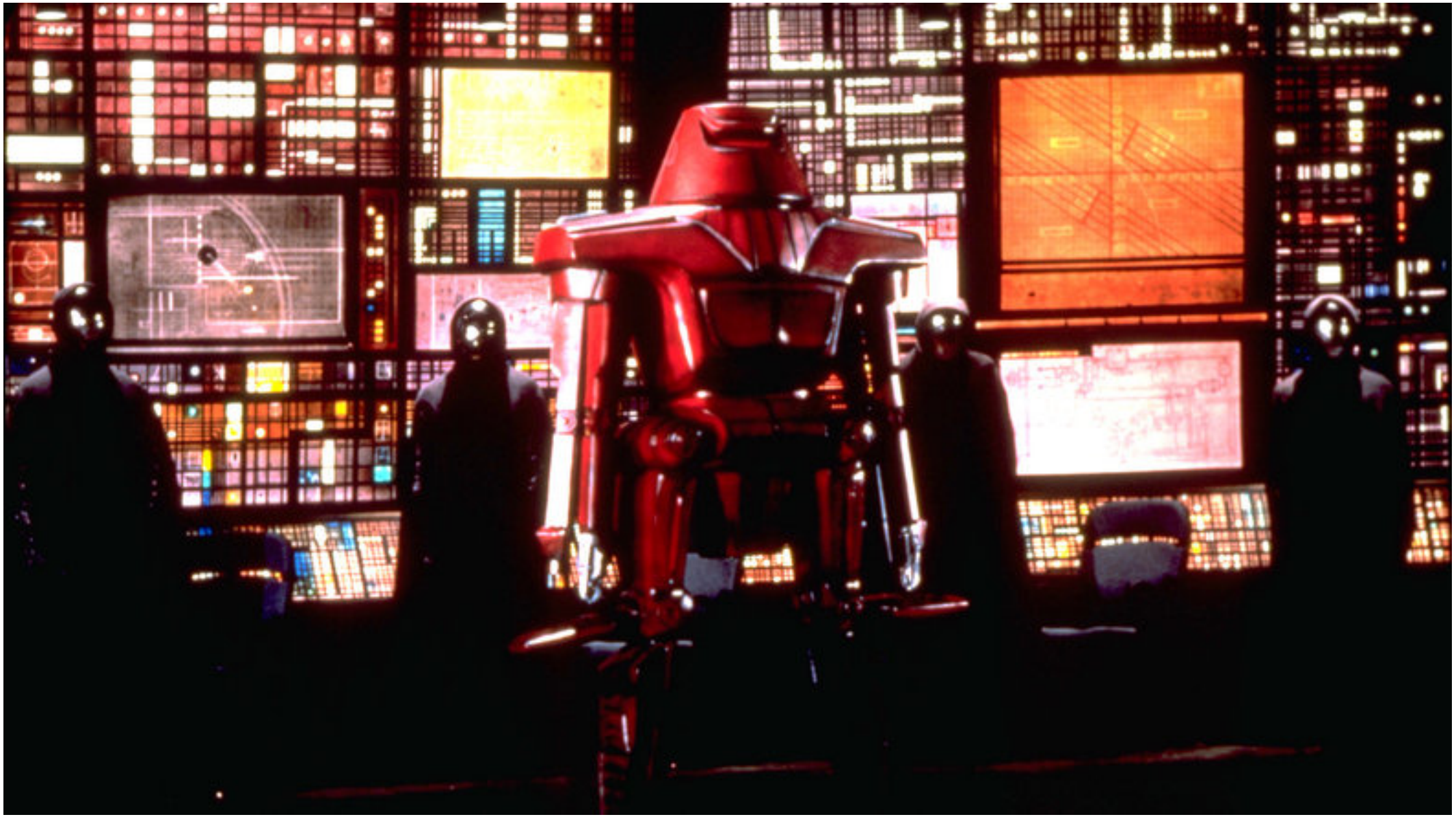

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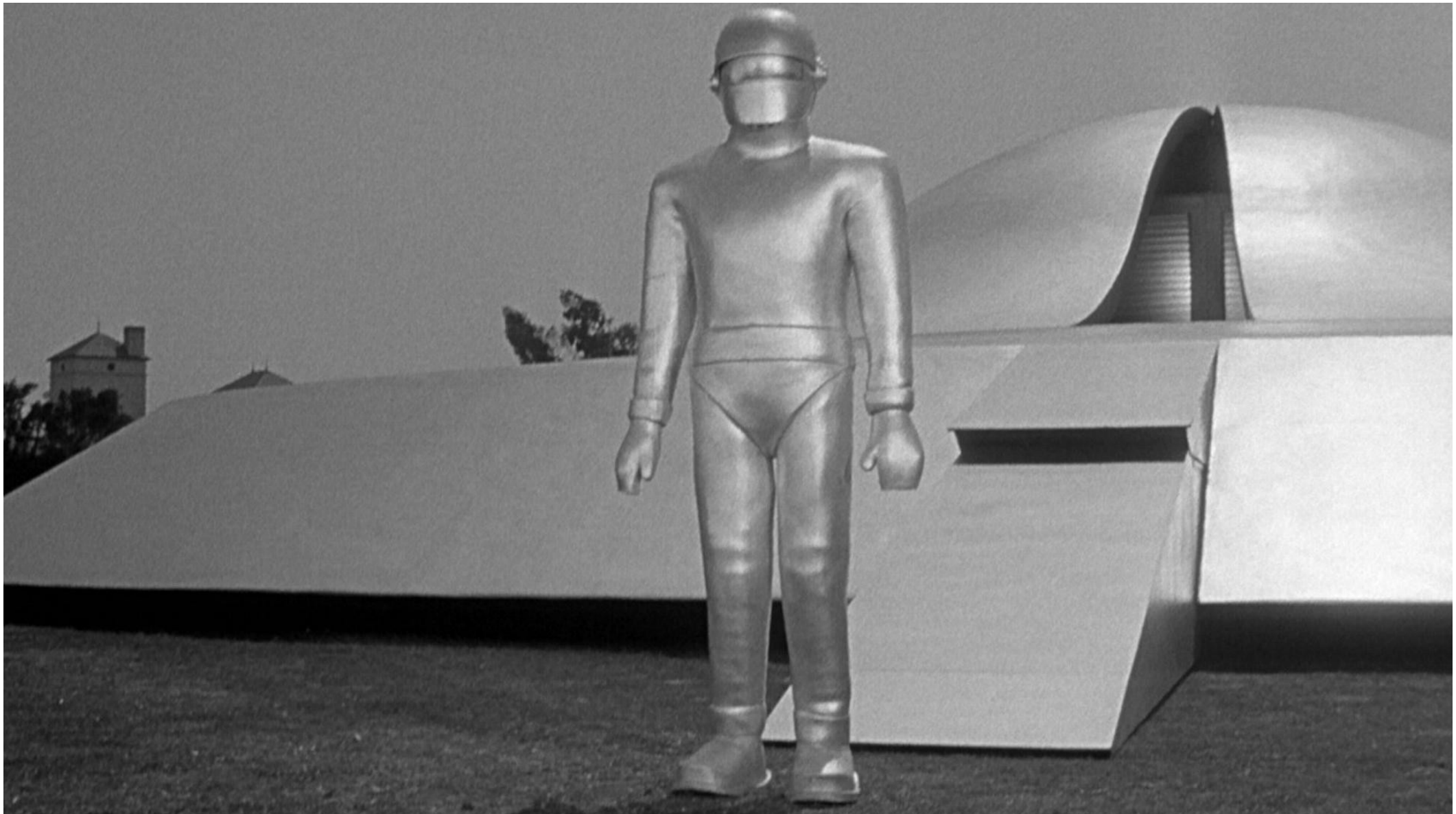
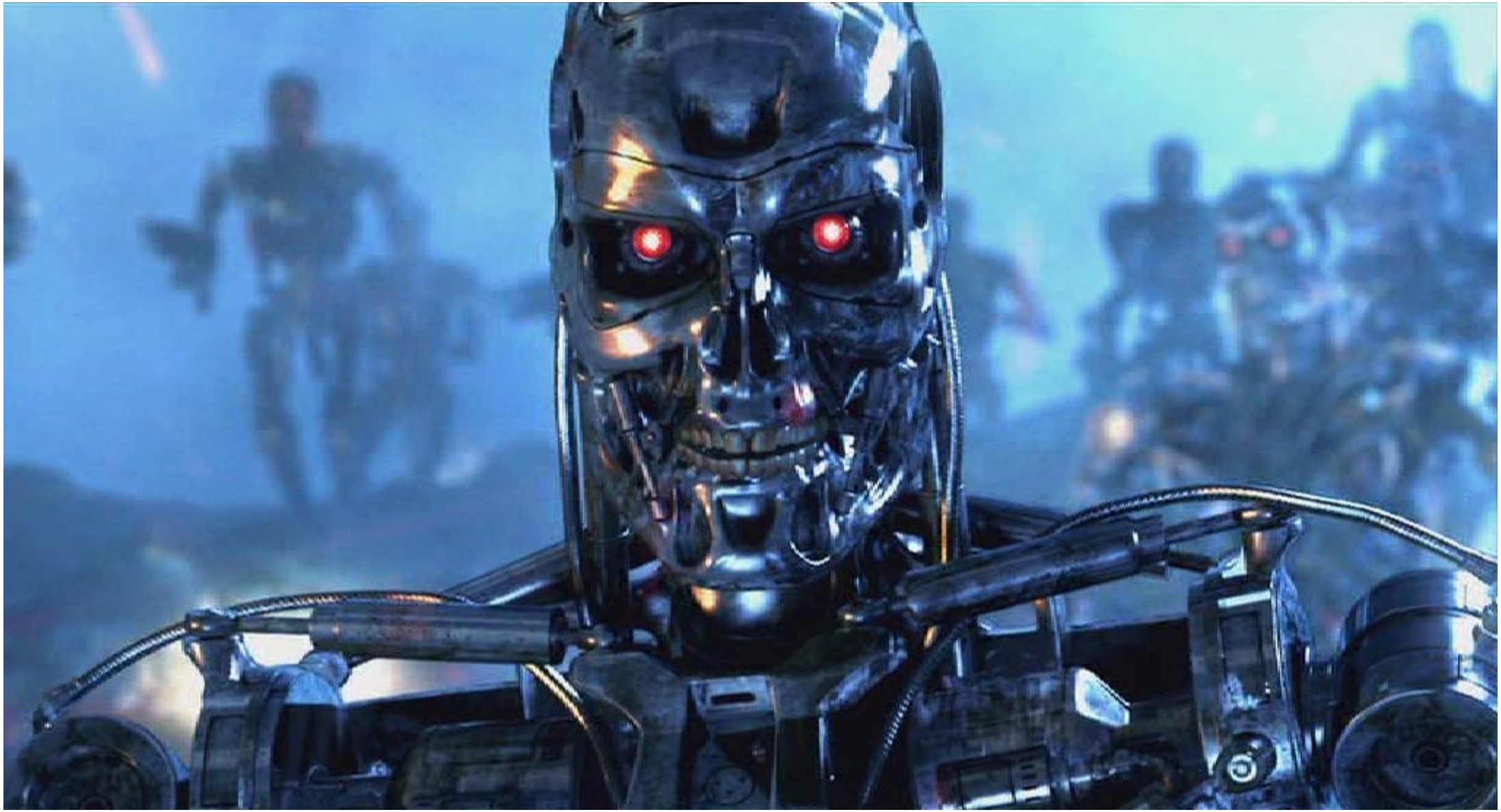


Robotics



Robotics

Consumer Robots

- TOMY made many toy robots that met the requirements of avoiding the uncanny valley
- For example, the Omnibot and Omnibot 2000


TC
T1
AL
T2
M
SET
STOP/EJECT
MIC
PLAY


TOMY
Omnibot 2000

Consumer Robots

- TOMY made many toy robots that met the requirements of avoiding the uncanny valley
- For example, the Omnibot and Omnibot 2000
- Robosapien


WALK FORWARD
LEFT
RIGHT

Consumer Robots

- Heathkit developed the Hero Jr., that was more of a hobbyist robot (1984)


HEATH
HERO·JR
HERO·JR

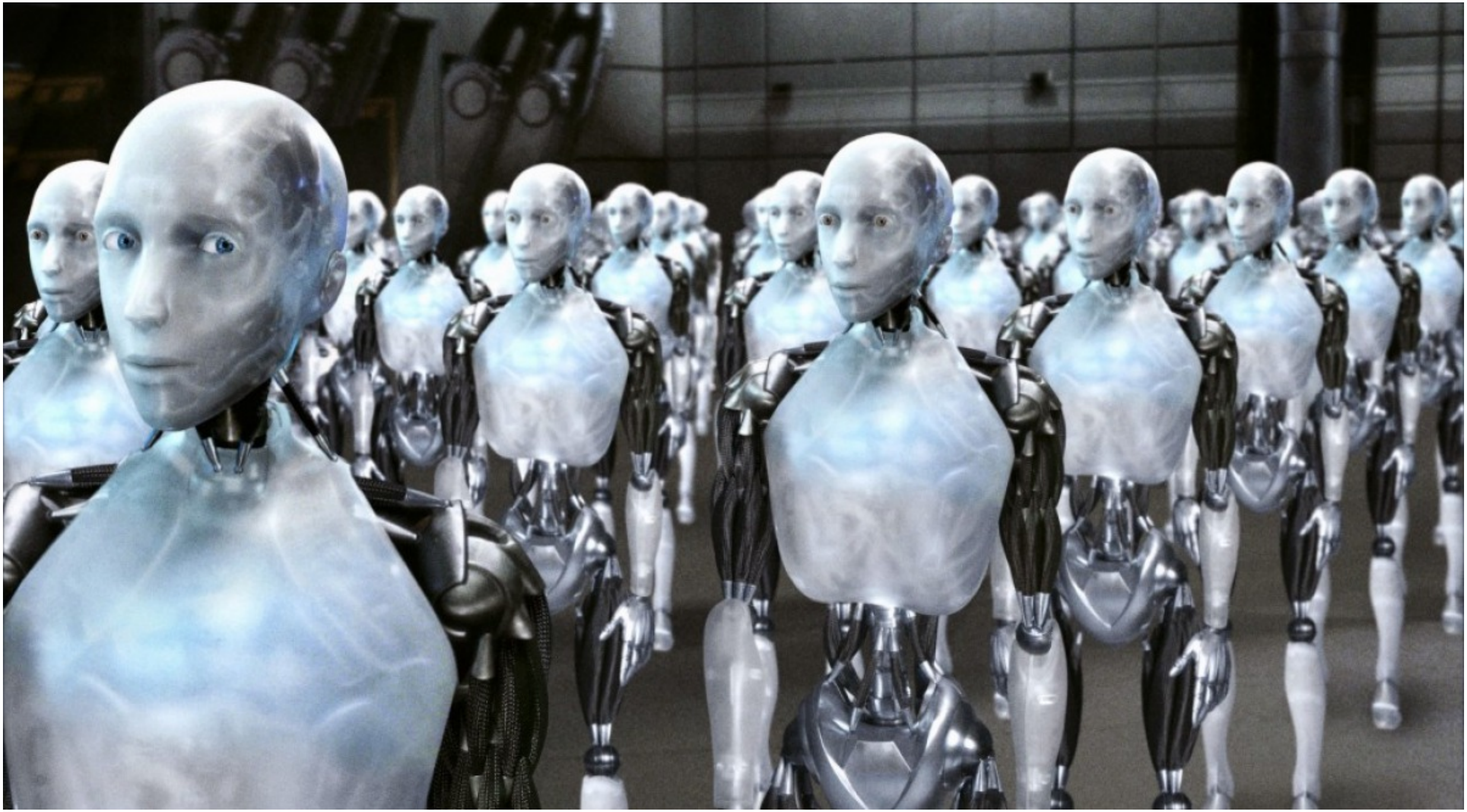
Consumer Robots

- Nintendo developed the Robotic Operating Buddy, or R.O.B.

Consumer Robots

- Now, robots are becoming more utilitarian at the consumer level
  - iRobot


DAY
HOUR
MINUTE
CLEAN
DIRT DETECT
DOCK
SCHEDULE
CLOCK
iRobot
Roomba



Consumer Robots

- Now, robots are becoming more utilitarian at the consumer level
  - iRobot
  - WinBot


WINBOT

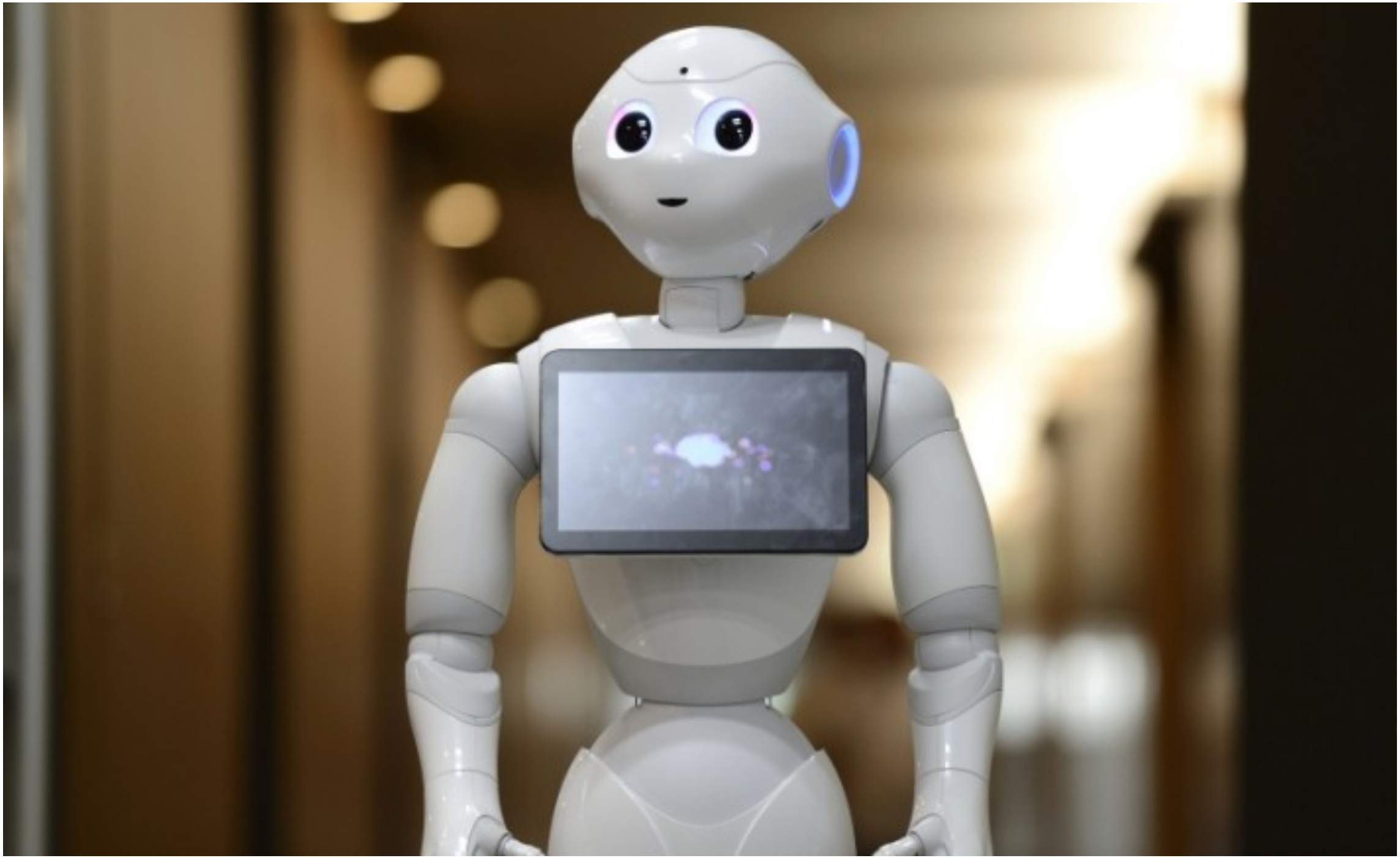

ECOVACS
GENEBOT

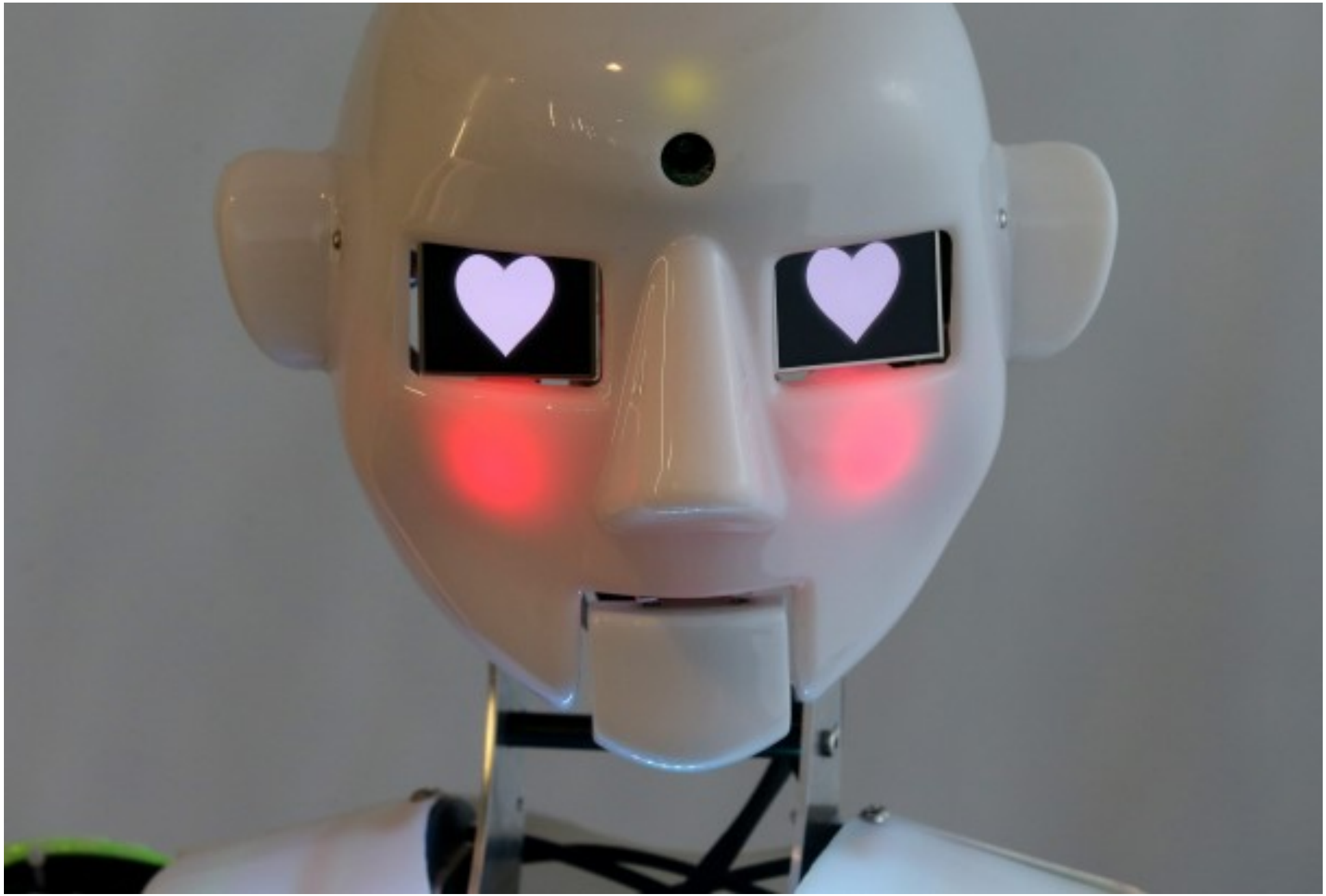
Consumer Robots

- Now, robots are becoming more utilitarian at the consumer level
  - iRobot
  - WinBot
  - NAO

Consumer Robots

- Now, robots are becoming more utilitarian at the consumer level
  - iRobot
  - WinBot
  - NAO
  - Pepper





Consumer Robots

- There has been severe concern recently over advanced AI, and deep learning
- This was addressed in 1943 by Isaac Asimov, with his three laws of robotics:
  1. A robot may not injure a human being, or through inaction allow a human being to come to harm
  2. A robot must obey the orders it receives from human beings, except when they violate the first law
  3. A robot must protect its own existence, as long as that protection does not violate the first two laws

Consumer Robots

- Similar to Moore's Law, the three laws of robotics are considered as valid guidelines
- Recently however, major companies including Microsoft, IBM, and Facebook have been investing heavily in 'Deep Learning'
- This has led to warnings from luminaries such as Bill Gates, Steve Wozniak, Stephen Hawking, Elon Musk, and 16,000+ researchers.
- Elon Musk even metaphored that it is 'summoning the demon.'

Consumer Robots

- We’ve already seen the beginnings of this in personal assistants such as Siri and Cortana
- More advanced examples include swarming robots and problem-solving robots
- Prefaces a discussion of AI
  - What is it, and what isn’t it
  - What are the potential risks
  - Examples

Consumer Robots

- Artificial intelligence has many forms
  - Chess-playing system
  - Expert system
  - Fuzzy logic
  - Neural network
  - Genetic algorithm
- Are these really a form of artificial intelligence?

TEN LEVELS OF AUTOMATION (LOA)*

High	10	**Full Autonomy**: The computer makes all decisions, acts autonomously, and ignores the human operator.
	9	The computer informs the human operator, only if it "decides" to.
	8	The computer informs the human operator, only if asked to.
	7	The computer executes automatically, then informs the human operator as necessary.
	6	Allows the human a limited amount of time to veto an action before it is automatically executed.
	5	The computer executes the suggestion with approval from the human operator.
	4	The computer suggests one alternative.
	3	The computer narrows the decision-making to a few selections.
	2	The computer offers a complete set of decision / action alternatives.
Low	1	**Manual Operation**: The computer offers no assistance to the human operator, who must make all decisions and take all actions.

Source: Chen, Barnes, Harper-Sciarini (2011)

Table 1 NARS Items with Subscales

Item No.	Questionnaire Item	Sub-Scale
1	I would feel uneasy if robots really had emotions.	S2
2	Something bad might happen if robots developed into living beings.	S2
3	I would feel relaxed talking with robots*	S3
4	I would feel uneasy if I was given a job where I had to use robots.	S1
5	If robots had emotions I would be able to make friends with them.*	S3
6	I feel comforted being with robots that have emotions.*	S3
7	The word "robot" means nothing to me.	S1
8	I would feel nervous operating a robot in front of other people.	S1
9	I would hate the idea that robots or artificial intelligences were making judgements about things.	S1
10	I would feel very nervous just standing in front of a robot.	S1
11	I feel that if I depend on robots too much, something bad might happen.	S2
12	I would feel paranoid talking with a robot.	S1
13	I am concerned that robots would be a bad influence on children.	S2
14	I feel that int the future society will be dominated by robots.	S2

(*inverse item)

Sub-scales:
S1: Negative attitudes towards situations and interactions with robots
S2: Negative attitudes towards social influence of robots
S3: Negative attitudes towards emotions in interactions with robots

Source: Nomura, *et.al.* (2003)

Industrial Robots

- Robots designed for industrial uses don’t normally need to consider aesthetics / design
- The most well known example are assembly-line robots
  - Automotive
  - Electronics
  - Textiles
- Amazon is using them extensively in Warehouses

Military / Law enforcement

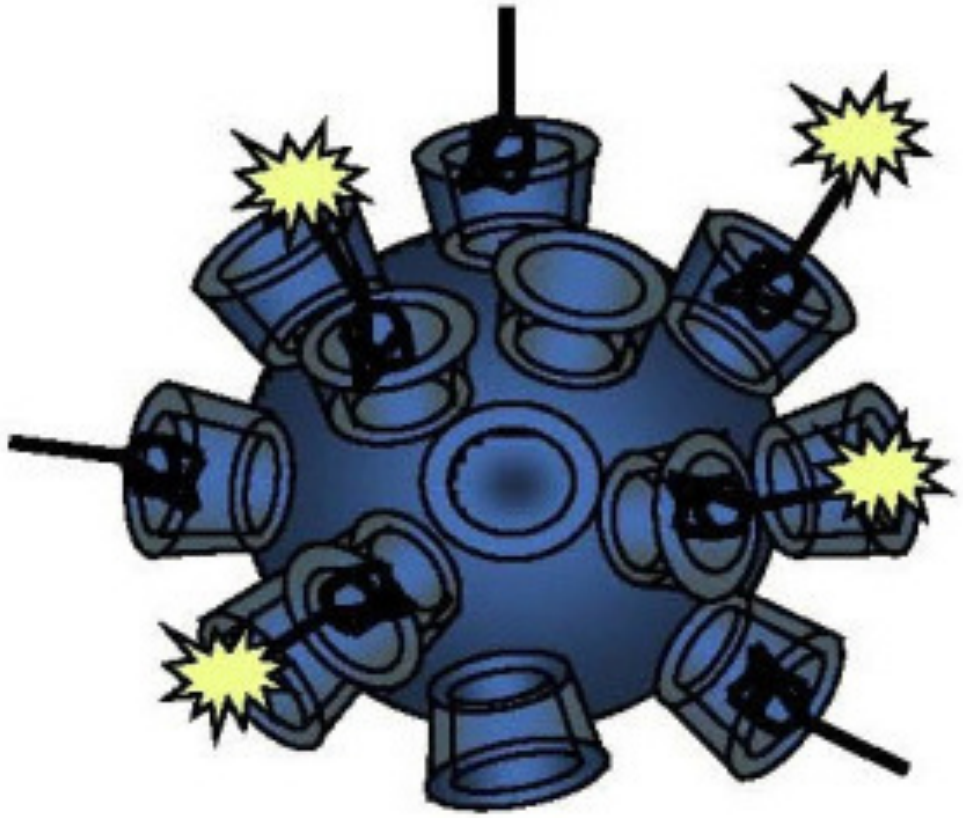
- Bomb sniffers / Diffusers
- Dangerous environments
- Soldier support
  - Big Dog
  - Titan
- Soldiers can develop an emotional attachment to robots, impacting their use

Medicine

- Surgical robots (DaVinci)

Medicine

- Nanobots (Not actual robots)



Medicine

- Exoskeletons

Prosthetics

- Advances in prosthetics are happening at a record rate
- Have gone from simple replacement to functional replacement
- As the technology improves, so does social acceptance and expectation
  - Appearance and behavior/movement is similar to what was replaced
  - Concept of how they work isn’t remarkable

Prosthetics

- Pain
- Death
- Infection
- Contractures
- Pressure sores
- Psychological trauma
- Adequate blood supply
- Edema/shrinkage/swelling
- Changes in transected bones
- Neuroma formation/sensory loss
- Desire to return to a “Normal Life”

Source: Robert N. Brown, CPO, FAAOP

Prosthetics

- Legs don’t require the same levels of functionality as other prosthetic targets
- That’s why the major focus of prosthetic development is arms, hands, and eyes
- Even so, prosthetic legs and arms have inclusions such as Bluetooth and app control
- Still a ways to go for full functionality, haptics, pressure, vision

Prosthetics

- Evolution of prosthetics

c. 1890

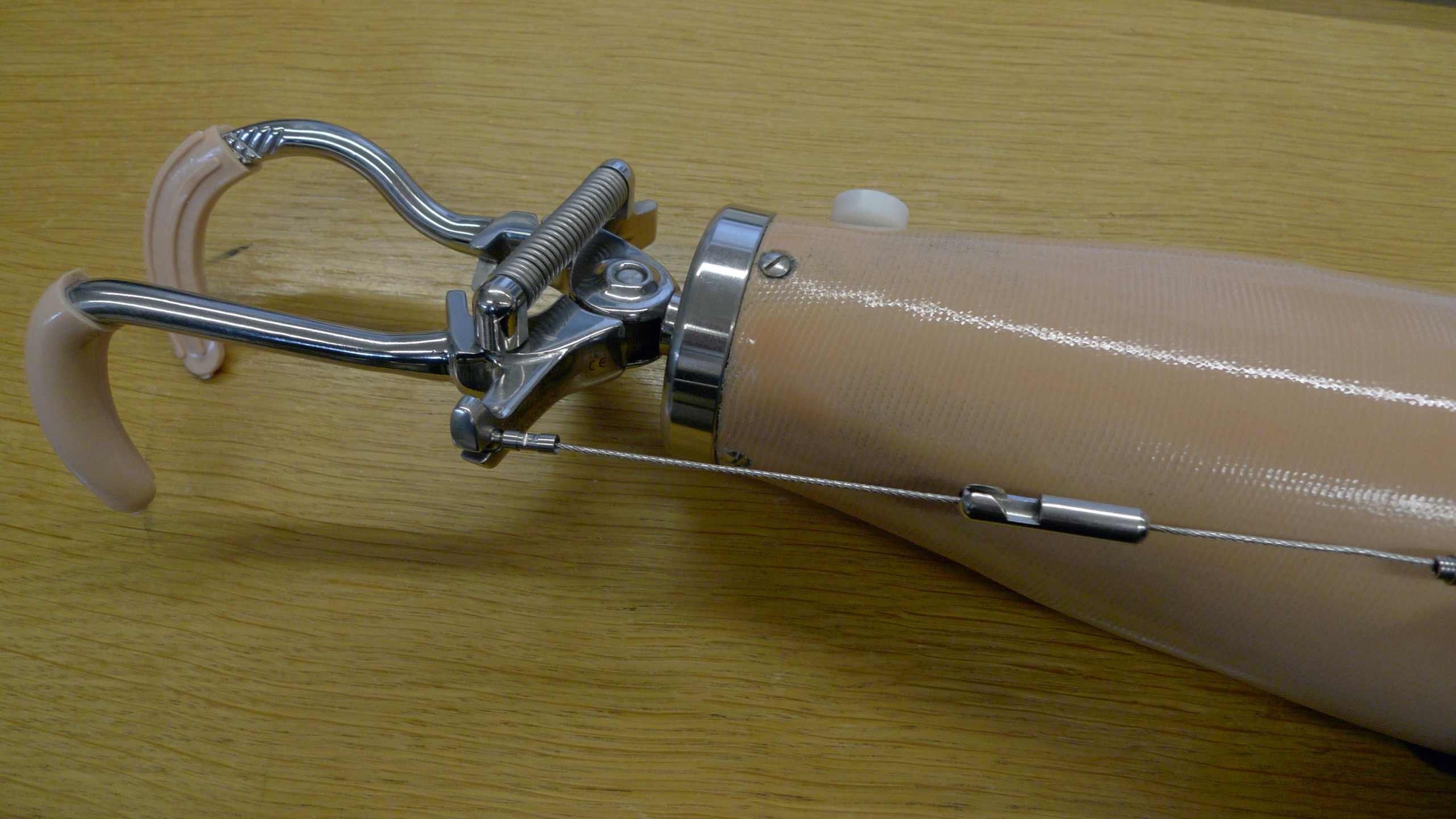
c. 1649

c. 1914-1918


4

c. 1840-1940

c. 1914-1918




APL
STEM CORPS
Applied Physics Laboratory

Tranhumanism

- The desire to improve and enhance the ‘human condition’
- Also considers the ethical implications of augmentation
- Some consider it very dangerous, while others consider it very brave
- Advanced prosthetics are an example of this movement