SCAN ME

IFR INFOGRAPHIC

IFR International Federation of Robotics

HUMANOID ROBOTS

VISION AND REALITY

HYPE ABOUT HUMANOIDS?

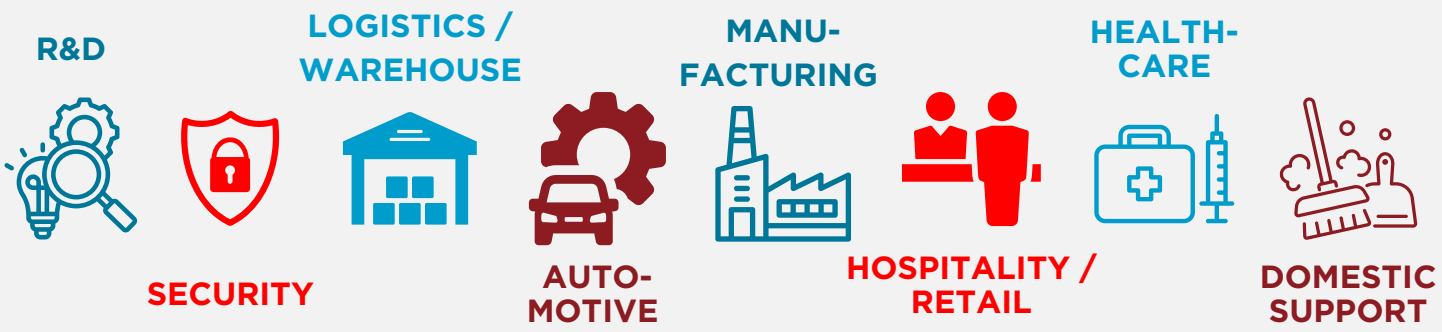
Interest is fueled by futuristic scenarios originated in science fiction.

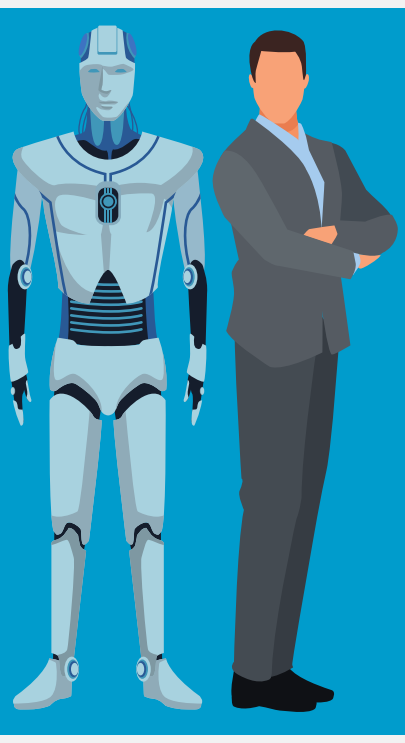
Recent videos on social media showcasing the potential of AI-powered humanoids have further boosted this interest, suggesting an impending revolution in robotics.

RECENT TECHNOLOGY TRENDS

- Advances in AI and machine learning: Generative AI supports new methods for humanoids to acquire their capabilities
  - learn from demonstration
  - figure out tasks independently.
- Improved core components
  - lighter, more durable materials and miniaturized components
  - tactile and force torque sensors
  - force feedback and compliance control
  - Improved SLAM and LIDAR systems

POTENTIAL KEY CUSTOMER INDUSTRIES





WHAT IS A HUMANOID ROBOT?

A humanoid robot is a robot with **human-like** aesthetic **appearance** (typically two arms with hands, two legs, torso and head) capable of **performing tasks in an environment designed for humans** without the need to adapt it.

Their task performance is enhanced by having **human-like sensing abilities** such as seeing, hearing, touch sensing, interacting with humans and environments.

(PERCEIVED) BENEFITS OF HUMANOIDS

01 Designed to operate in human-centric environments

02 Universal general-purpose helper to address lack of labor

03 New, intuitive way of training robots supported by Generative AI

04 Versatile - can support both industrial as well as service tasks

REGIONAL DIFFERENCES

- **US** tech companies and private investors provide significant funding.
- **China's** government has ambitious goals to mass produce humanoid robots soon.
- Strong venture capital available.
- **Japan** envisions them to support its ageing society.
- **Europe** emphasises safety, efficiency and the ethical implications.

TRADEOFFS AND LIMITATIONS

NO MASS PRODUCTION

Humanoids are so far only produced in small numbers. There is not yet a mass production reaching economies of scale regarding costs.

PERFORMANCE

Humanoids will not compete with traditional industrial robots in terms of speed, precision, reliability and repeatability.

PUBLIC FEARS: UNCANNY VALLEY

Their human-like appearance and behavior can create fear in people, leading to a general rejection of robotic technologies.

BATTERY LIFE

Battery power is a fundamental challenge for humanoid robots. So far, a battery cycle does not las a full working day.

SAFETY

Humanoids must continuously maintain their balance. There are significant risks of damage and injuries linked to falling and power failure.

STANDARDISATION

ISO TC 299 has just started the process to develop a globally accepted safety standard for humanoids and other legged robots without intrinsic stability.

EXECUTIVE SUMMARY

FULL POSITION PAPER