A Call for Embodied AI

•*Giuseppe Paolo*
•*Jonas Gonzalez-Billandon*
•*Balázs Kégl*

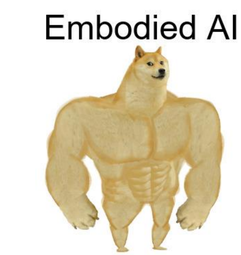
Noah's Ark Lab – Huawei

Embodied AI agents

- Non passive observers of their world: they live in it and interact with it
- Sensory-motor coupling with the environment
- Continuously learn and evolve
- Can be controlled in a direct way by setting their goal

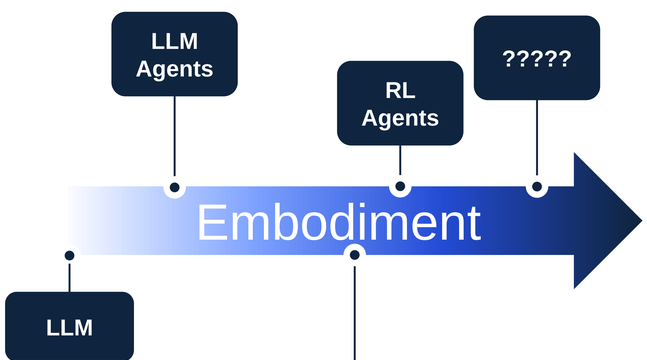
Internet AI

- Trained on static, curated datasets
- Completely separated from the environment
- Not designed to understand causal relationships
- Only identify proximate context and correlations
- Do not adapt to the world, need retraining



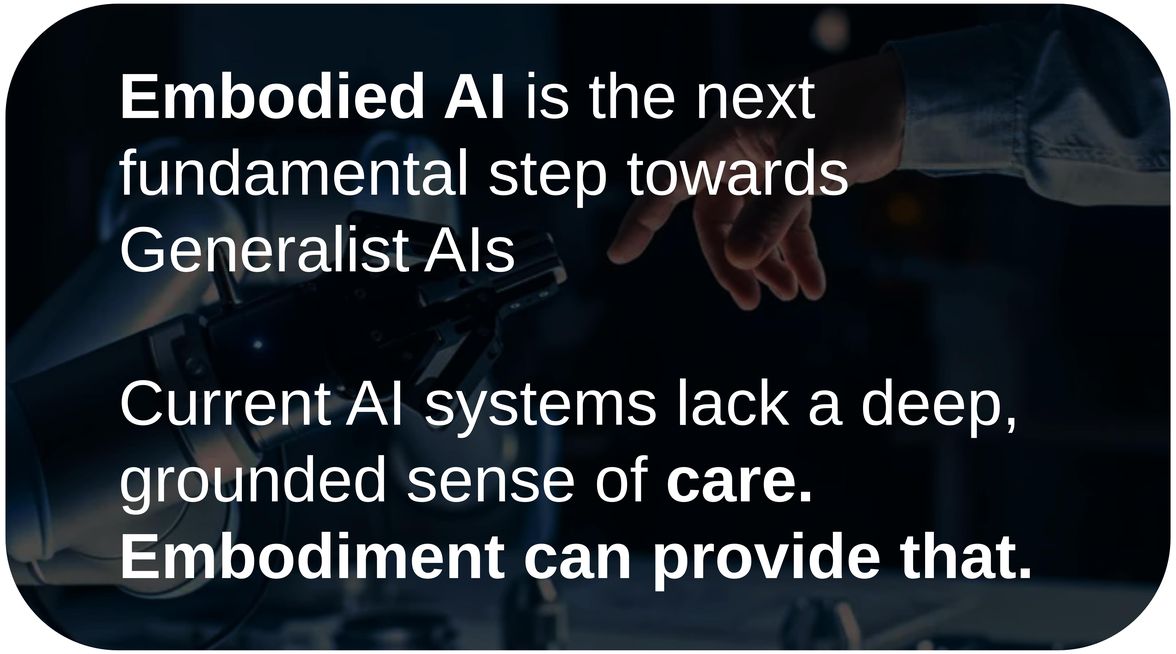
Coupled to its environment.
Easily adapts to it. Goal driven.

Static, non adaptable.
Difficult to align. Needs
a lot of data preparation.



Social Media Content AI Recommendation Systems (SMAI)

- Ubiquitous (e.g. Facebook, Amazon, Netflix…)
- Clear objectives: maximize the user engagement
- Continuously adapt to environment: the user
- Controlled by changing their goals
- Almost invisible

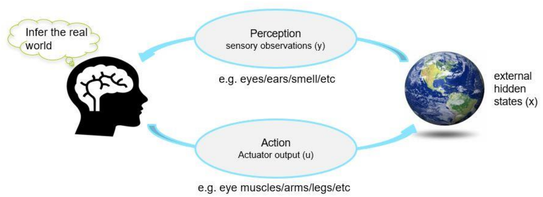


Embodied AI is the next fundamental step towards Generalist AIs

Current AI systems lack a deep, grounded sense of **care.**
Embodiment can provide that.

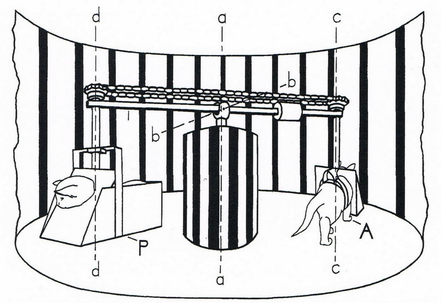
Why Embodiment?

- **Friston's Active Inference Principle**
  The brain minimizes the discrepancy between its perceptions and its predictions of the state of the world



- **Robotics experiments by Ishiguro & Kawakatsu (2004)**
  - Theory and practical application in robotics.
  - Close and effective integration of control mechanisms with body dynamics
  - Enhanced energy efficiency

- **Kitten carousel experiment by Held & Hein (1963)**



  - Two kittens in a carousel:
    - one can **interact** with the carousel
    - the other is only a **passive observer**
  - Both receive **identical** visual input
  - The kitten engaged in active interaction exhibits normal visual development.
  - The passive kitten does not exhibit normal visual development.

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ICML
International Conference
On Machine Learning

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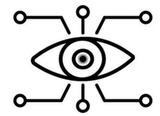
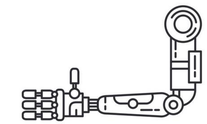
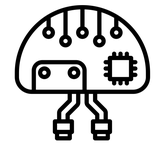
Components



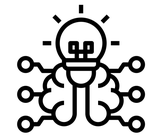
Perception
The ability to sense its environment



Action
The ability to interact with and change its environment



Memory
The capacity to retain past experiences



Learning
The ability to integrate experiences to form new knowledge and abilities

Challenges

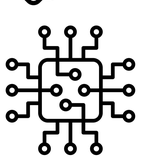
New Learning Theory
Learning agents have to adapt to a dynamically changing environment.

Noise and Uncertainty
The world is not completely observable and sensors and actuators are noisy.

Simulators
We will need light and accurate simulators to replace static datasets.

Interaction with Humans
Proper interaction reduces fear and helps adoption. LLMs can help with this.

Generalization
Adapting to unseen settings is fundamental for a truly generalist agent.



Hardware Limitation
Current AI systems are computationally heavy and power hungry.