Beyond Wires: The Future of Ubiquitous Sensing and Edge Intelligence

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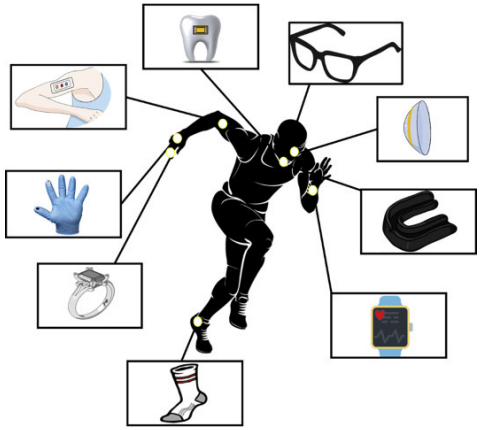
WiSense 2025

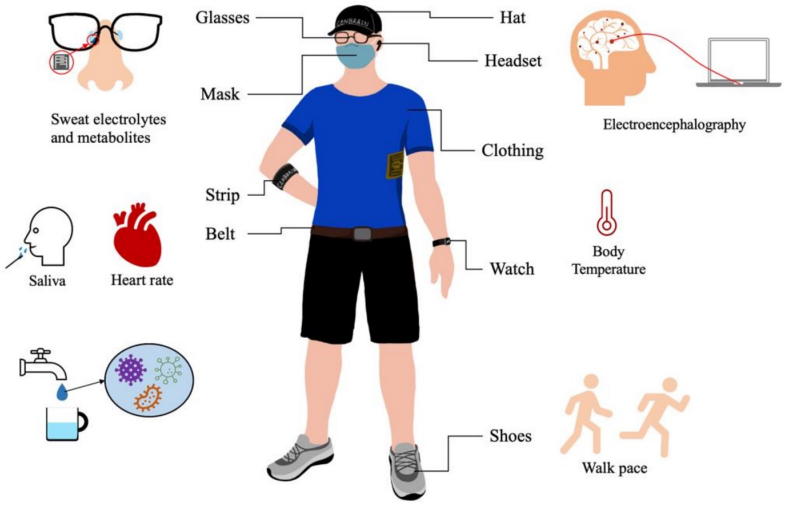
Ubiquitous Sensing



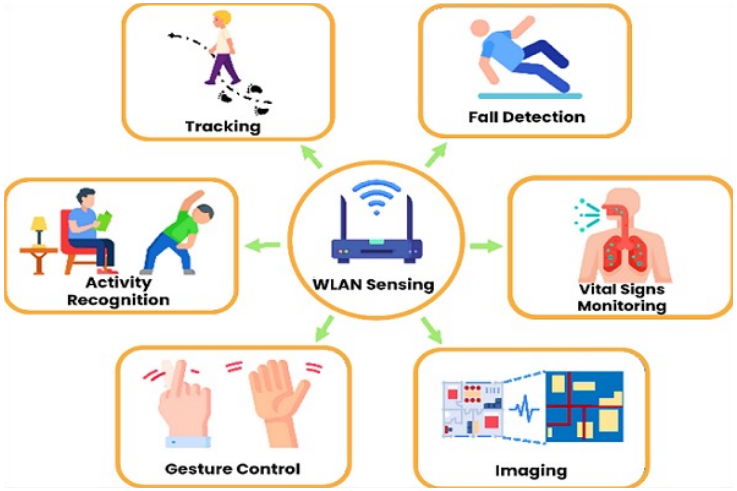
Sensors are everywhere – on our bodies, in our homes and cities.

[1] https://www.sciencedirect.com/topics/medicine-and-dentistry/wearable-sensor
[2] https://blog.switch-bot.com/what-is-a-smart-home/
[3] https://soracom.io/blog/what-is-the-future-of-iot-in-smart-cities/

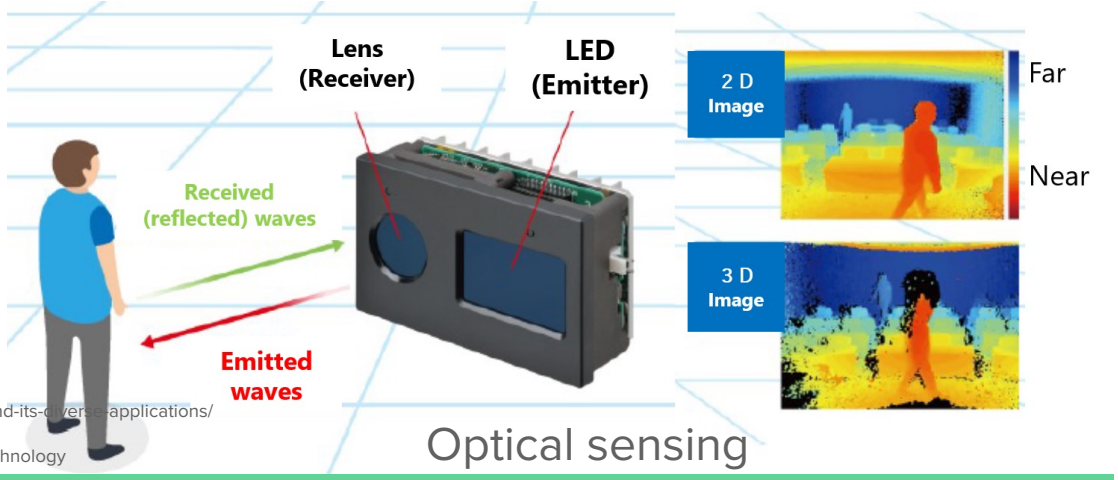
Recent Trends



Wearable sensing



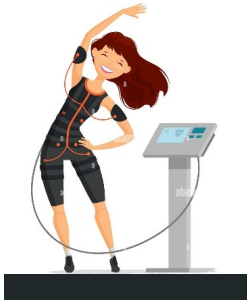
Wireless sensing



Optical sensing

[1] https://www.srfsteleinfra.in/wi-fi-sensing-a-comprehensive-look-into-the-technology-and-its-diverse-applications/
[2] https://www.mdpi.com/1424-8220/21/11/3806
[3] https://components.omron.com/eu-en/technology/key-technology/optical-sensing-technology

Wearable Sensing



Example:
Human
Behavior
Sensing

Elderly diseases

- Parkinson
- Alzheimer

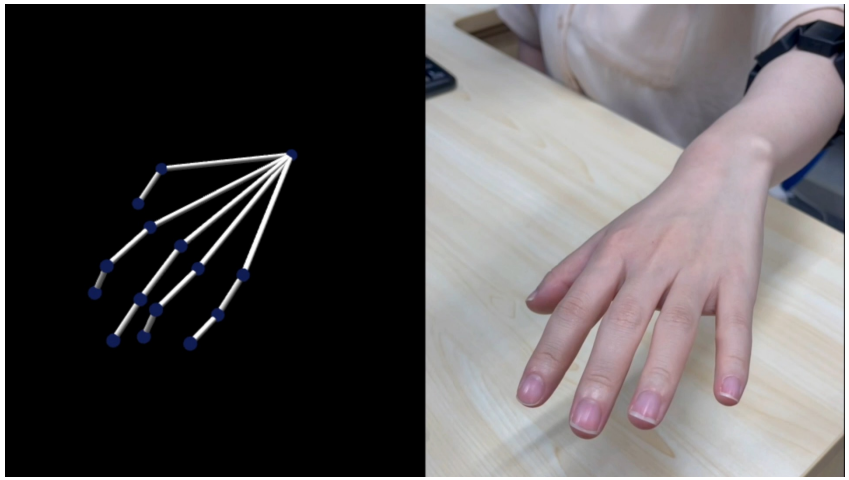
Problems with motion

- Disordered motion
- Slow motion
- Repeated motion
- Instability
- …

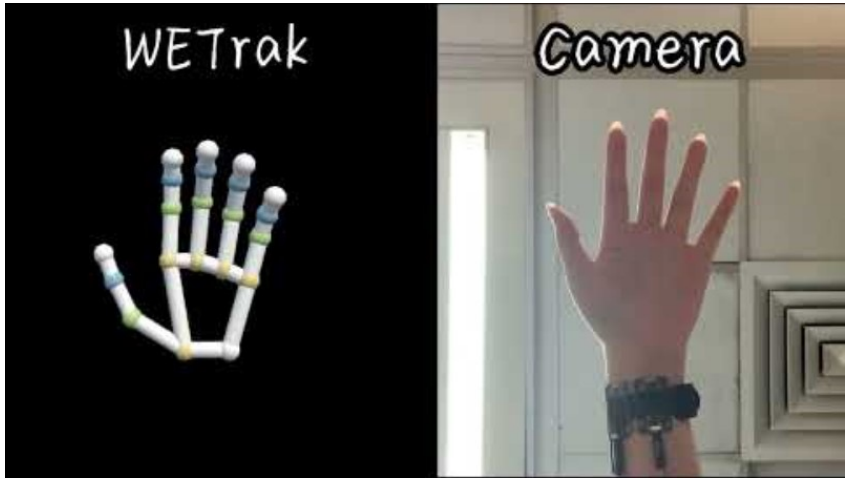
Example:
Human
Behavior
Sensing

ArmTroi [MobiSys'19]

WR-Hand [IMWUT'21]

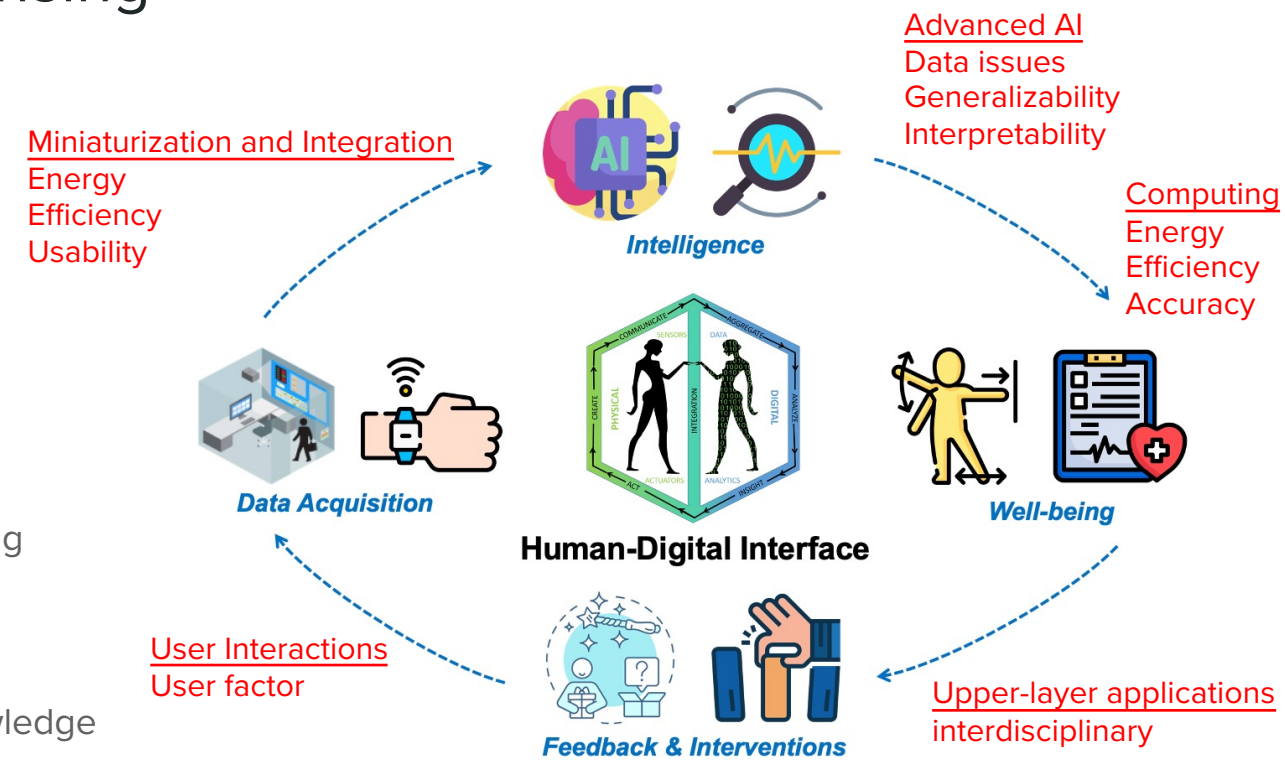


WETrak [TMC'24]



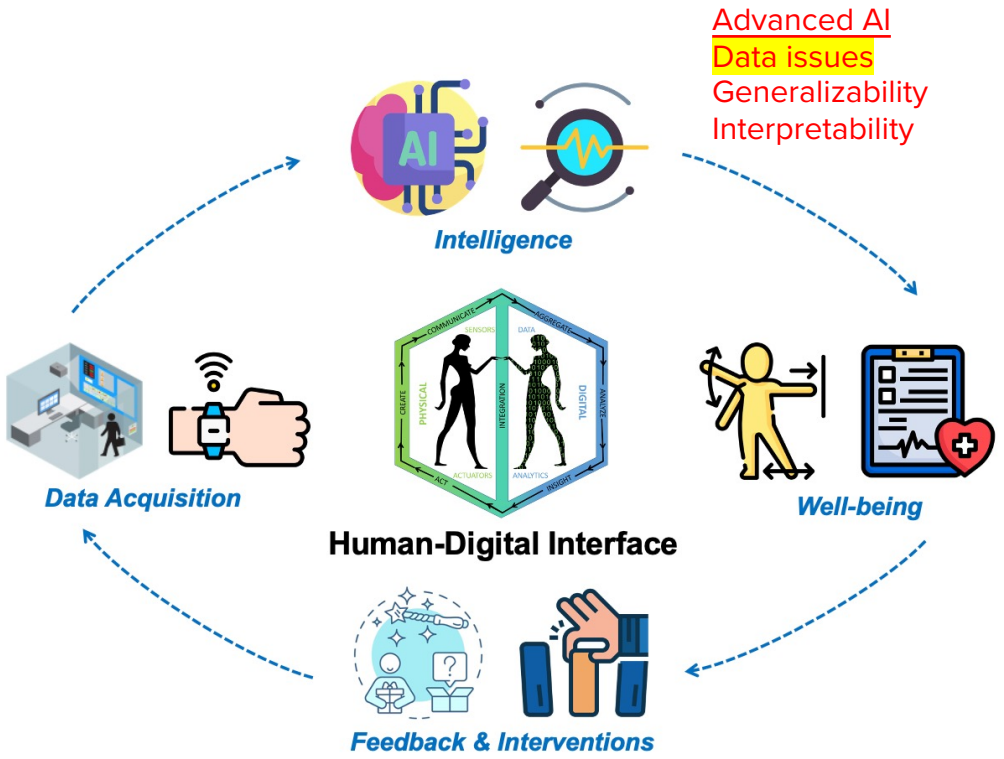
Human-centred sensing

- Data acquisition
  - Form factors
  - Sensing modalities
  - Communication
  - User factors
- Intelligence
  - AI
  - Signal processing
  - Physical understanding
- Computing
- Interventions
  - Domain-specific knowledge



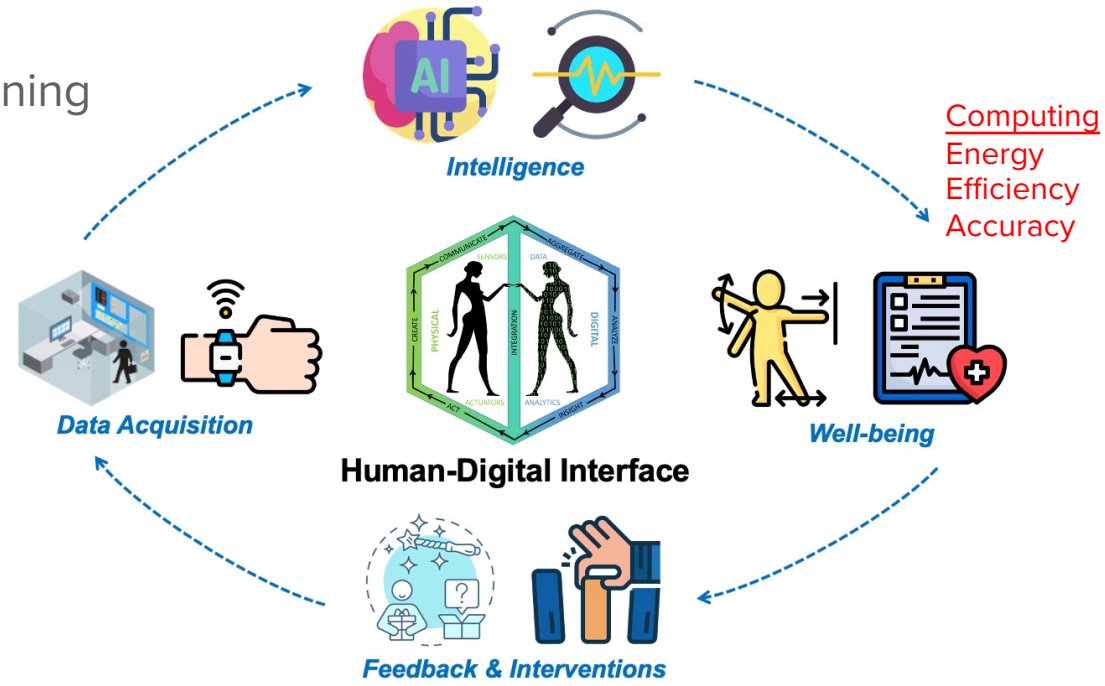
Roles of Generative AI

- Data issues
  - Limited data
  - Incomplete data
  - Noisy data
- Generative AI
  - Synthetic Data Generation
  - Reconstruction of Missing Data
  - Data Denoising



Roles of Edge Computing

- Real-Time Inference
- On-Device Training or Fine-Tuning
- Privacy Preservation



Wearable Sensing + Wireless Sensing

- Macro + Micro Views
- Failover and Redundancy
- Data Fusion