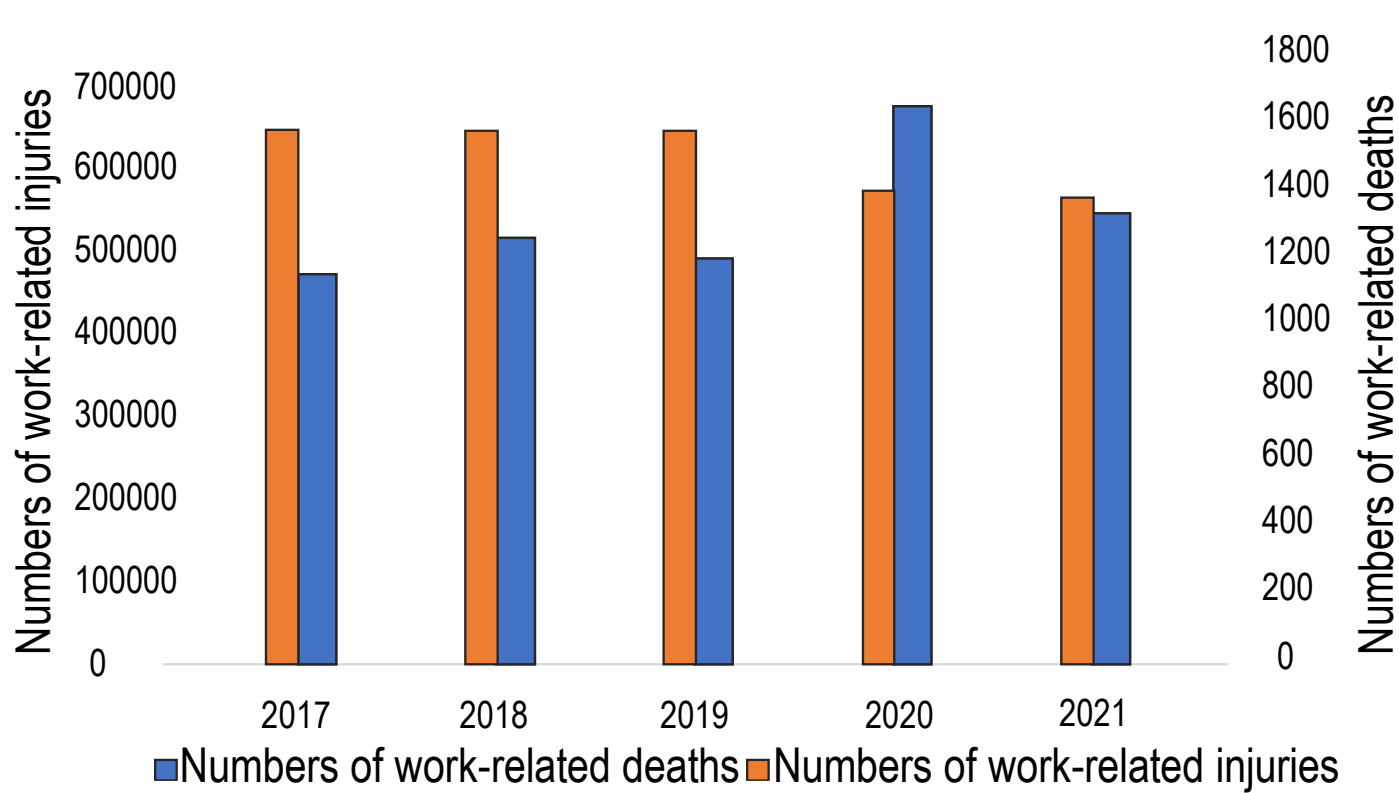


## Research context and motivation

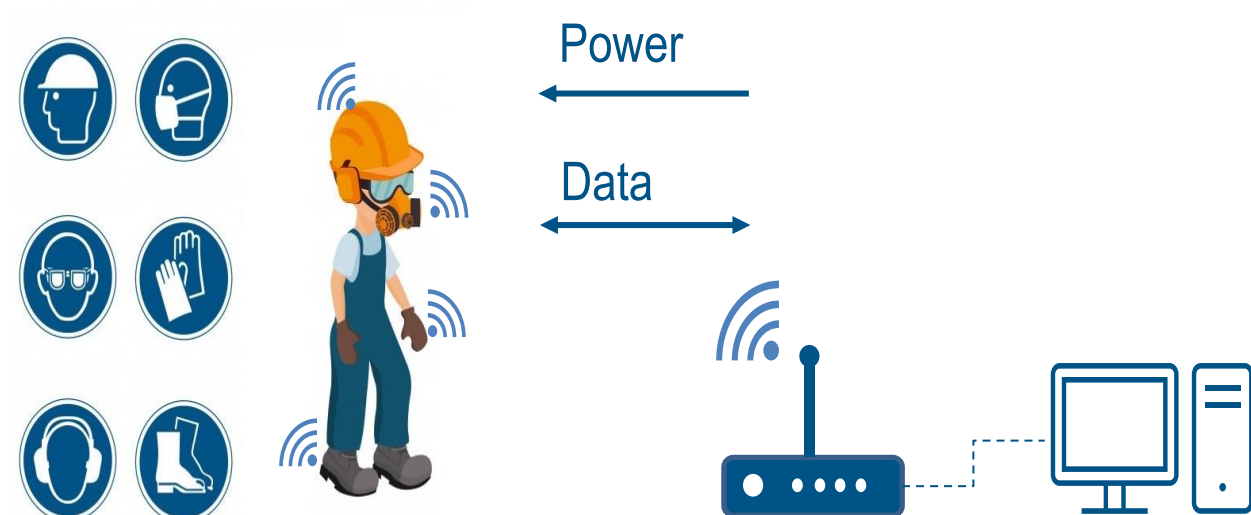
- Regional project **SPAS4S** about **Smart Personal Protective Equipment (SPPE)** in cooperation with:
  - Lanzi Group
  - Mechatronic Thinking
  - Ideas & Motion
- PPE is used to minimize exposure to workplace injuries, even though they remain very high.



More than **500,000** injuries and **1,000** work-related deaths were recorded in the year **2021** (Data from INAIL).

## Addressed research questions/problems

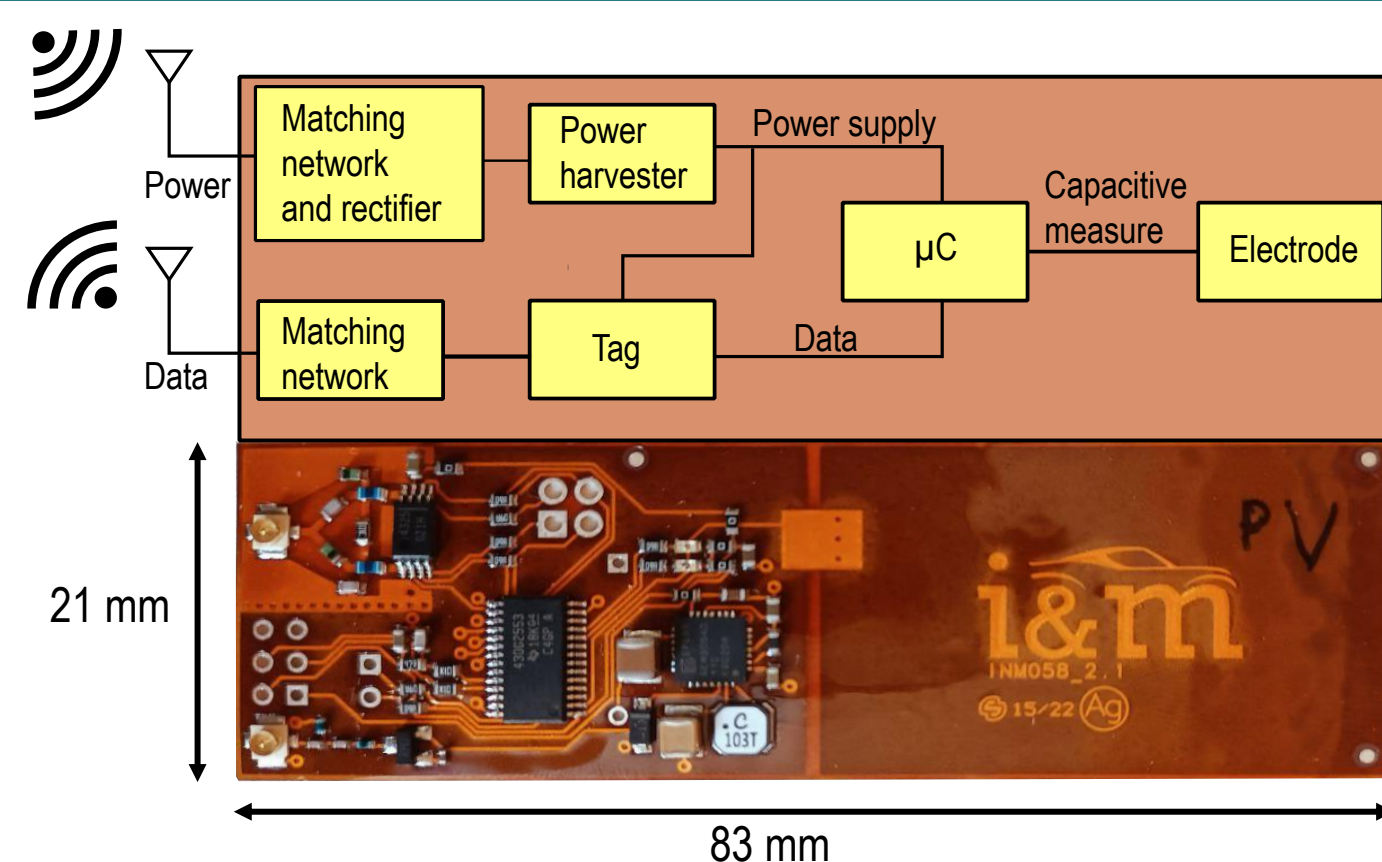
- The project aims to develop a **wireless, smart electronic and IT system** with advanced **remote-powered sensors** to detect in **real time** the wearing and use of the required PPE.
- Reduce** employee exposure to **hazards**.



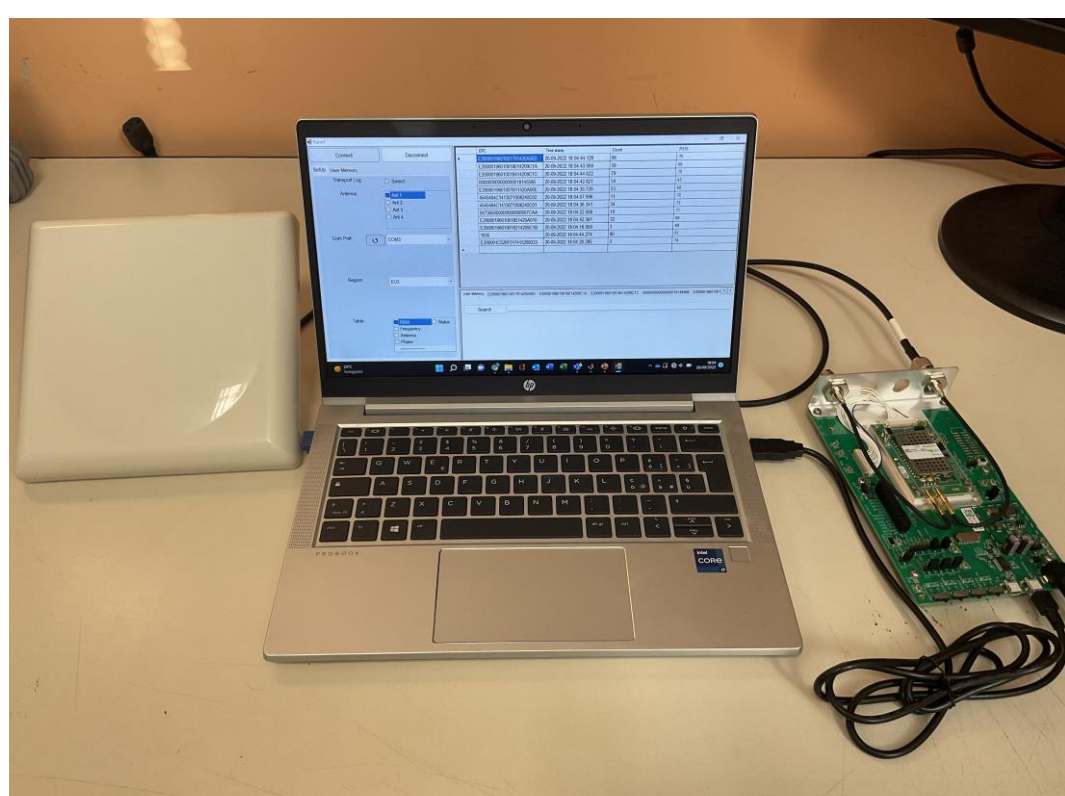
## Novel contributions

### Peripheral node – Smart sensor

- Wearable**
- Battery-less**
- Low power**
- Capacitive sensing**
- Real Time acquisition**



### Transmitter - Reader



- A **GUI** was developed to **configure the reader M6e**, **display data in real time** and **run tests** on the **overall system**.

## Adopted methodologies

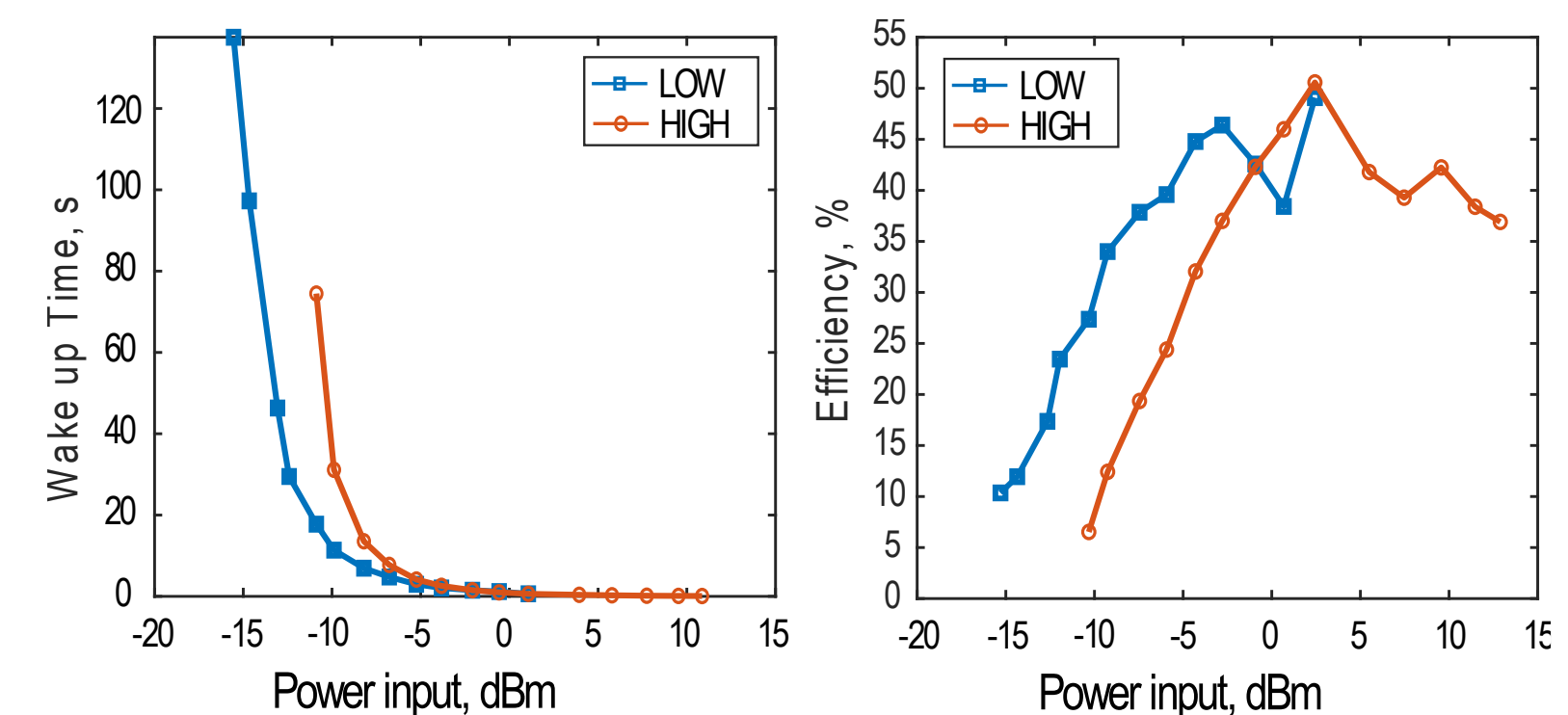
### Bullet points

- Power management system**
- Transmission data configuration**
- Firmware optimization**
- System integration**

### Experimental results

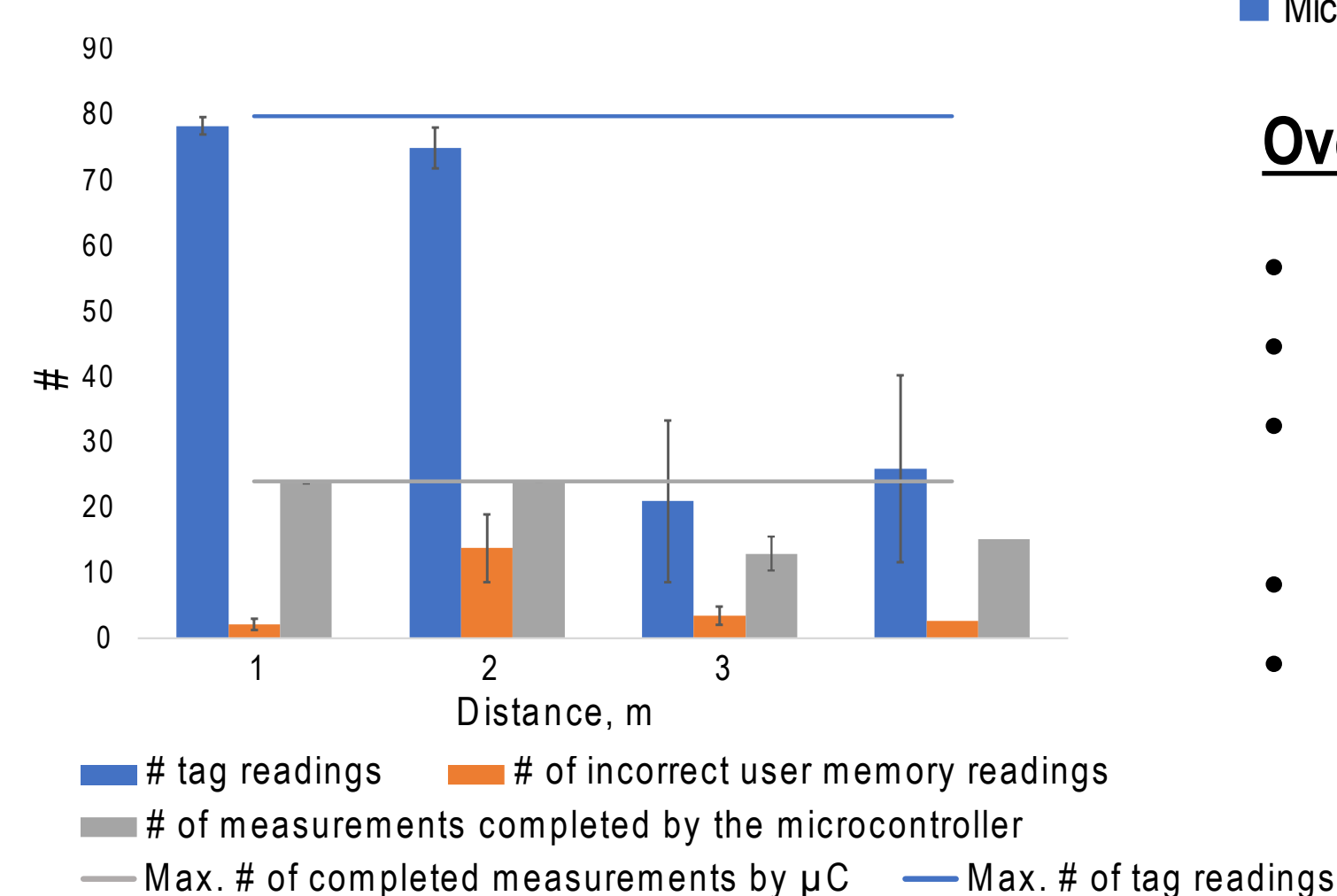
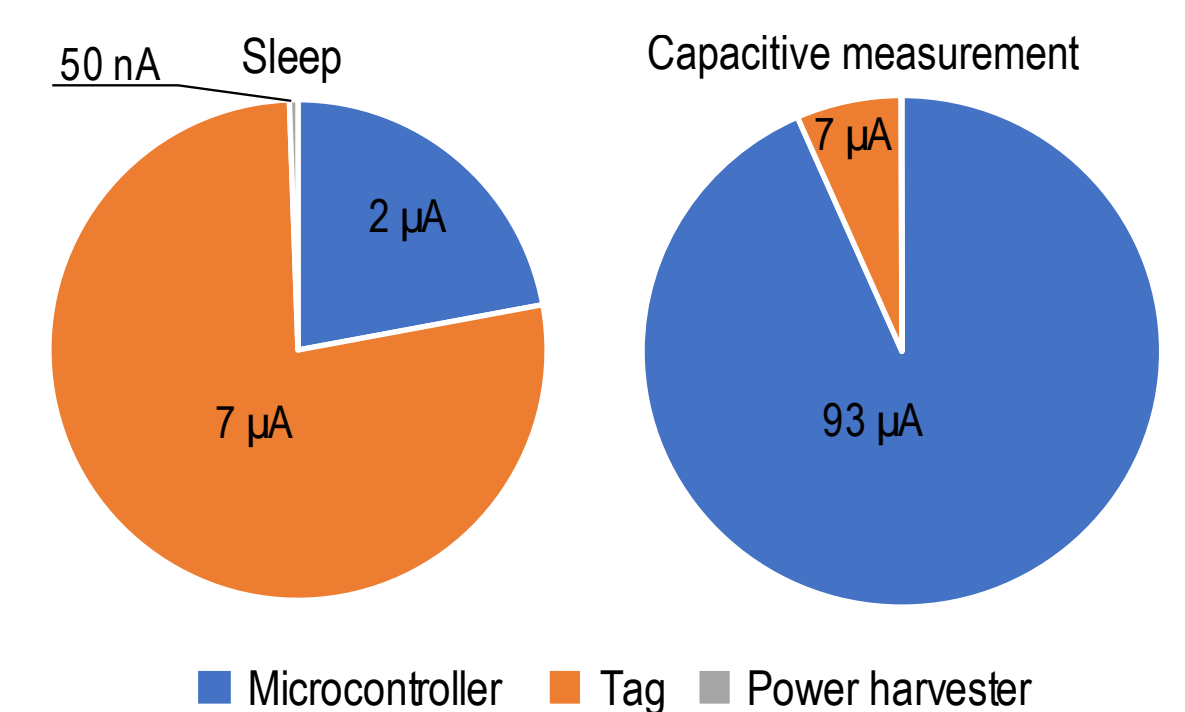
#### Power harvester:

- Input power **-16 to 11 dBm**. Matching networks for “LOW” and “HIGH” power. **150 µF** capacitor.
- Charging time 10 s** **efficiency 35 %** at **-10 dBm**.



#### Power consumption of smart sensor:

- Maximum** current consumption during capacitive measurement **100 µA**
- Sleep time 5 s**
- Measurement time 15 ms**



#### Overall system test:

- Tested distances from **1 to 4 m**
- 6 repetitions** for each distance
- 2-minute tests**
- Maximum performance up to 2 m**
- Higher variability > 2 m**

## Future work

1. Improve the RF matching network
2. Design the tag antenna on the PCB
3. Power consumption improvements
4. Functional tests using different PPE

Achieve good performance at 4 m

## List of attended classes

- 02LWHRV – Communication (4/1/2022, 1)
- 01QTEIU – Data mining concepts and algorithms (3/2/2022, 4)
- 01SHMRV – Entrepreneurial Finance (8/1/2022, 1)
- 01UNVRV – Navigating the hiring process: CV, tests, interview (9/1/2022, 1)
- 01DUCRV – Principles of digital image processing and technologies (22/7/2022, 5)
- 02SFURV – Programmazione scientifica avanzata in matlab (26/5/2022, 6)
- 08IXTRV – Project management (15/12/2021, 1)
- 01RISRV – Public speaking (22/12/2021, 1)
- 01SYBRV – Research integrity (6/1/2022, 1)
- 01SWQRV – Responsible research and innovation, the impact on social challenges (11/1/2022, 1)
- 01DNHRV – System level low power techniques for IoT (15/7/2022, 4)
- 02RHORV – The new Internet Society: entering the black-box of digital innovations (8/1/2022, 1)
- 01SWPRV – Time management (30/11/2021, 1)
- 01QEZRv – Sviluppo e gestione di sistemi di acquisizione dati (23/9/2022, 5)

## Submitted and published works

- Del Bono F., Bontempi A. Di Trani N. Demarchi D., Grattoni A. Motto Ros P., “Wireless Power Transfer Closed-Loop Control for Low-Power Active Implantable Medical Devices, Sensors, Dallas, 2022