Innovative Wireless Sensing for Cyber-Physical Security

Laboratorio T4, Cyber 4.0

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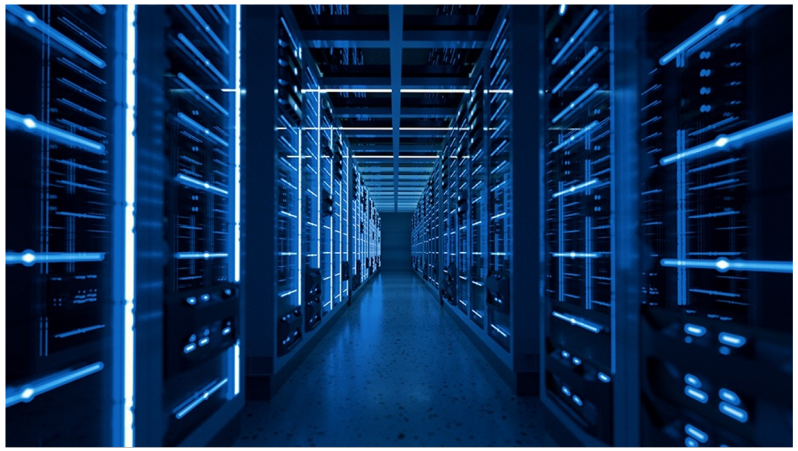
Background

Industry 4.0's digitalization has interconnected industrial systems, increasing their vulnerability to cyber attacks.

Critical infrastructure often relies on outdated operational technology (OT) systems prioritizing stability over security, making them particularly susceptible.

Motivation



Cluster of servers

Chemical plant

Electrical plant

Industrial automated engines

Thermal power plant

Pharma Lab

Industrial cyber attacks

Bushehr Nuclear Power Plant
Tehran, Iran (2010)

STUXnet

North Power Plant,
Kiev, Ukraine (2016)

BlackEnergy

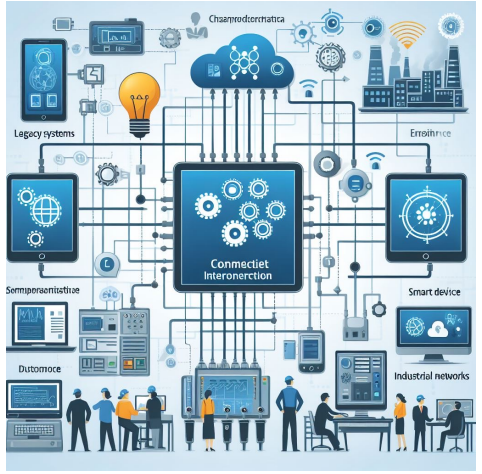
Merck Pharma Company
Kiev, Ukraine (2017)

'NotPetya'
CYBER ATTACK

Colonial Pipeline
Houston, Texas (2021)

DarkSide Ransomware

Challenges



TECHNOLOGICAL COMPLEXITY

TARGETED ATTACKS

MISSING UPDATES

MONITORING DIFFICULTIES

RATIONALE

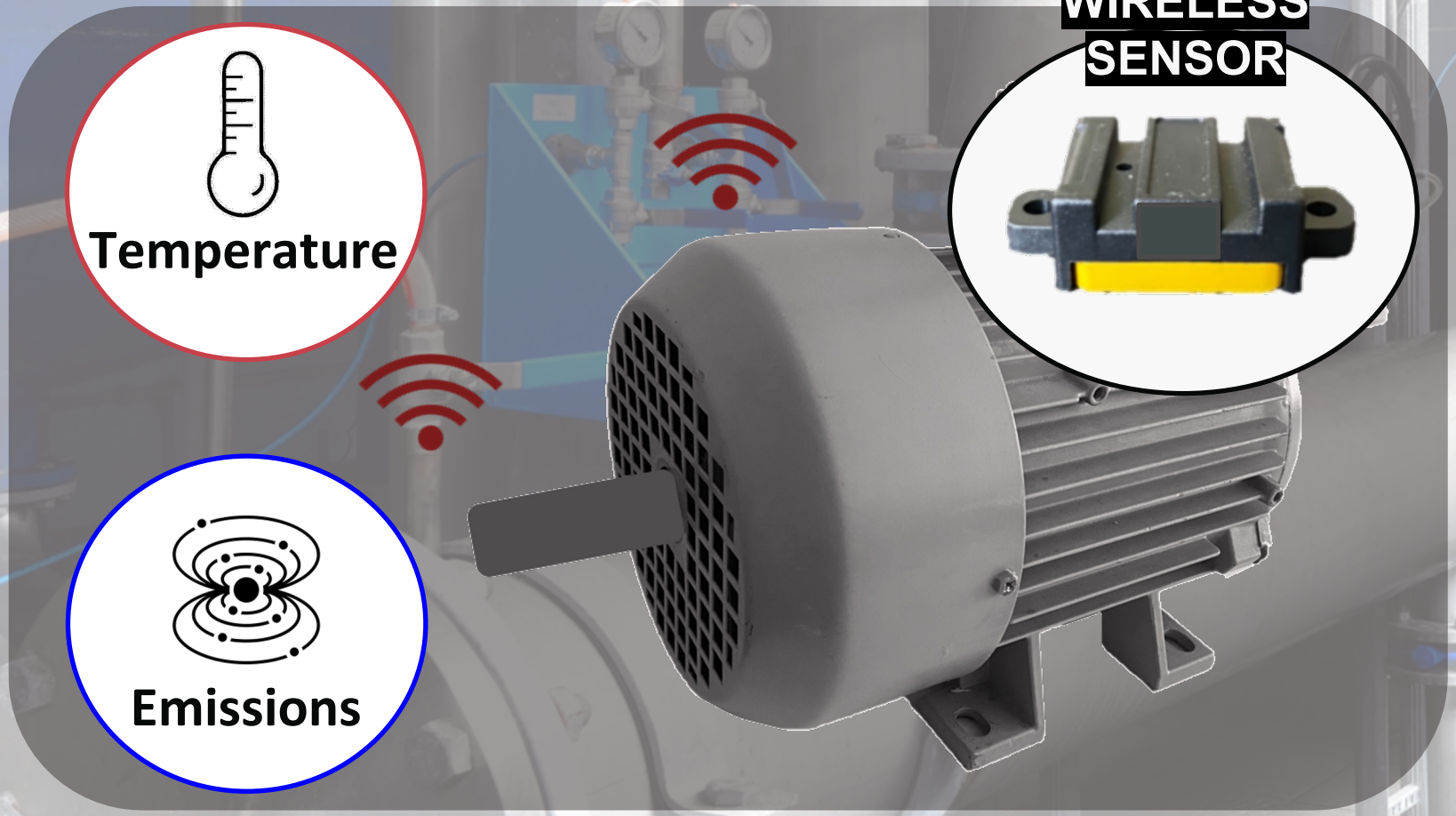
Engines, servers, and other electrical equipment can be damaged/destroyed by changing the operative conditions via the Internet (e.g., changing speed, load, ventilation…)

EM and Thermal profiles define a unique **Multi-Physics Fingerprint** of the crucial equipement

DEFENCE BY DISTRIBUTED SENSING

Early detection of cyber-physical attacks using distributed temperature and electromagnetic emission measurements

SCENARIO



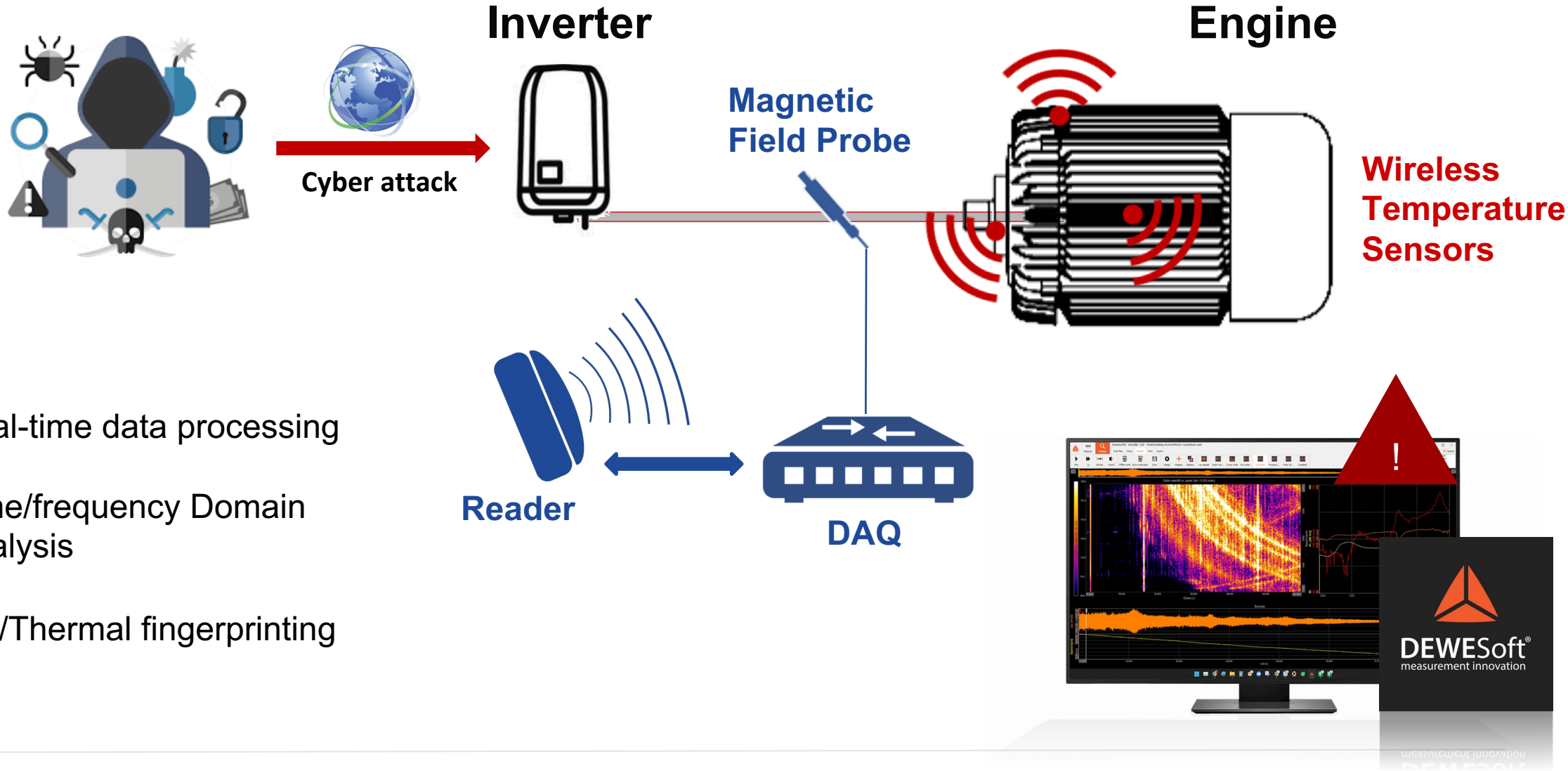
Zero/Low power batteryless wireless sensors

Low enviromental impact

Great capillarity

Monitoring of the inacessible

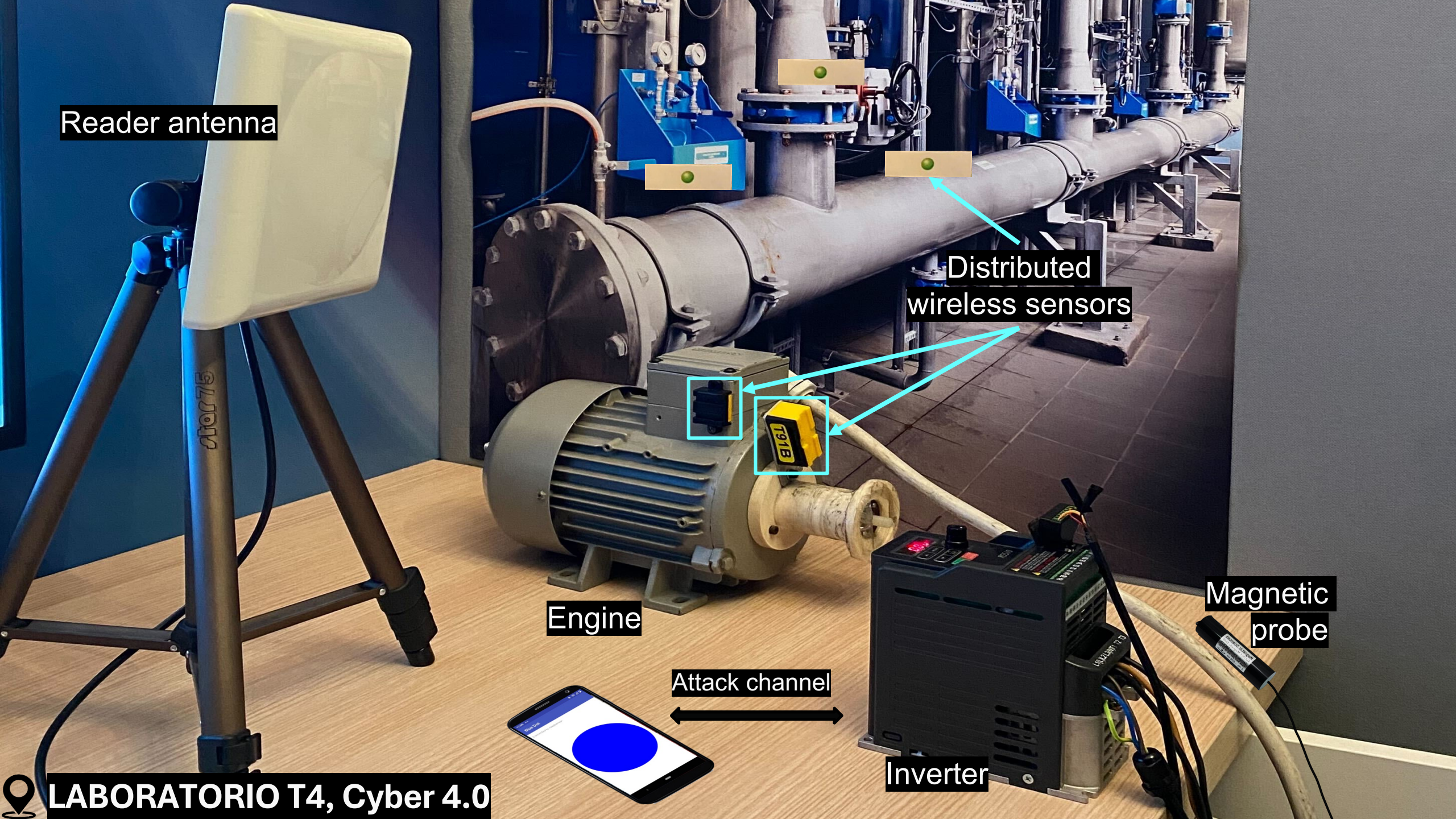
System Architecture



Real-time data processing

Time/frequency Domain Analysis

EM/Thermal fingerprinting


Reader antenna
Distributed wireless sensors
Engine
Magnetic probe
Attack channel
Inverter
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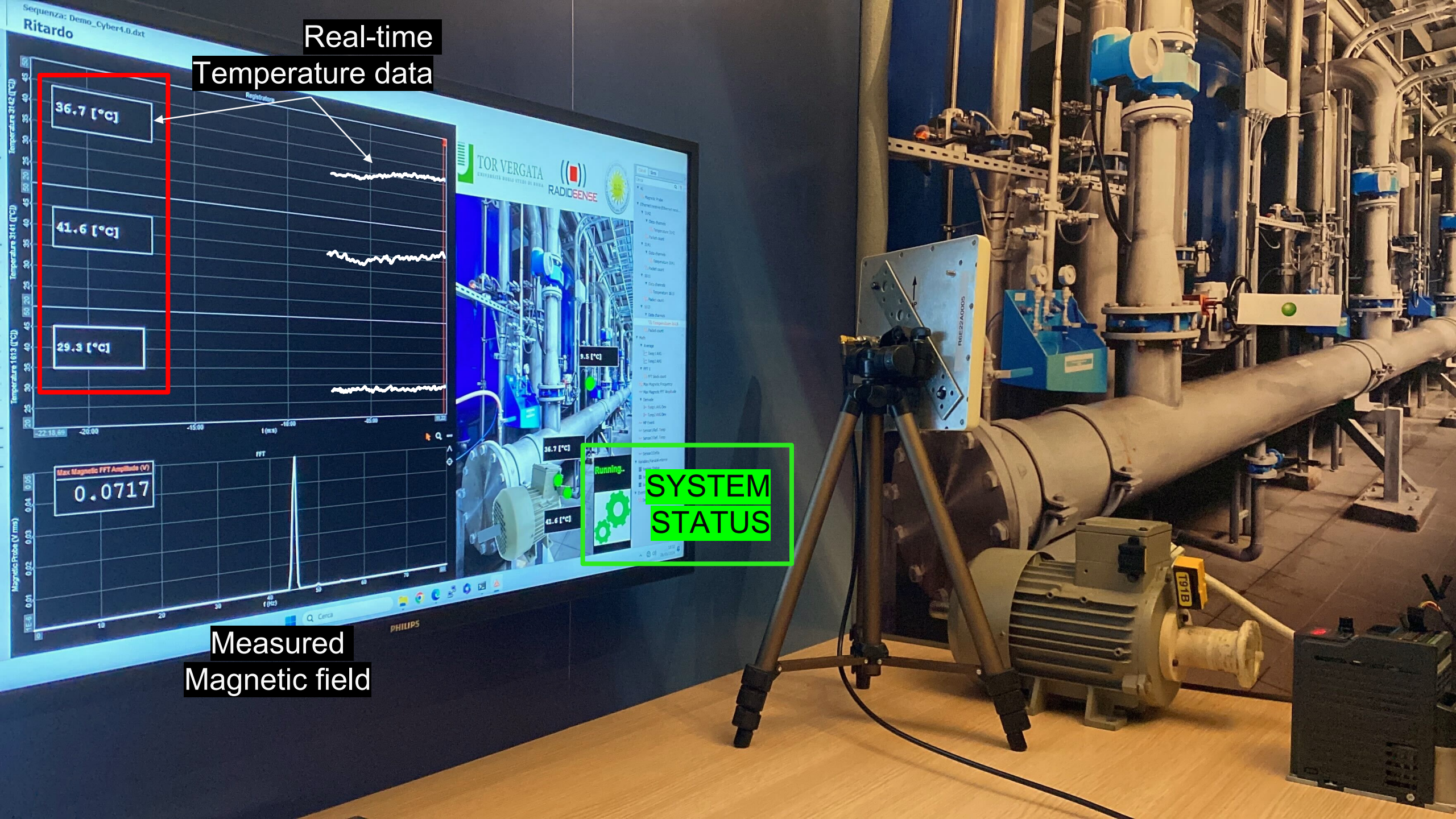
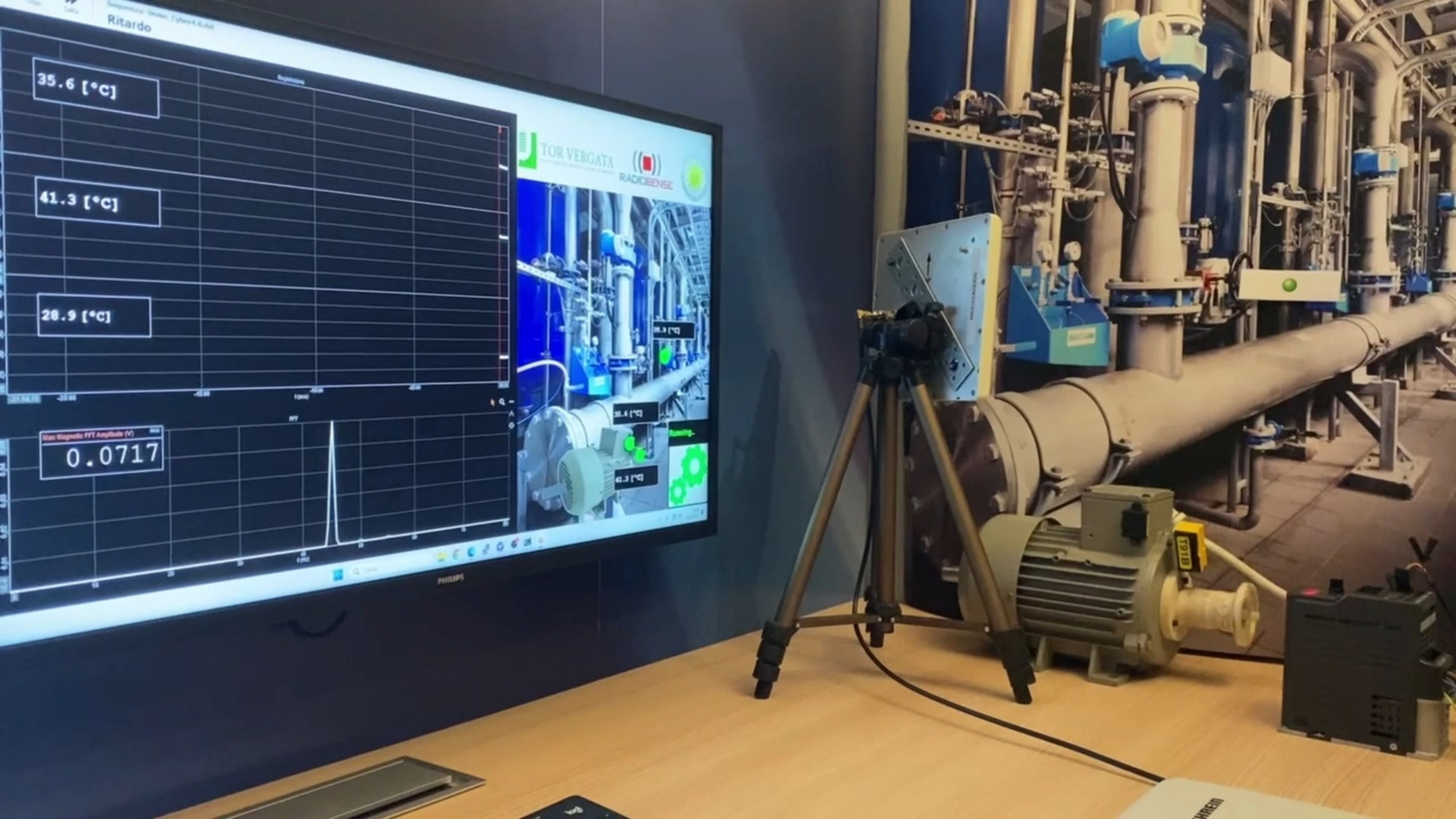

Real-time
Temperature data
36.7 [°C]
41.6 [°C]
29.3 [°C]
Max Magnetic FFT Amplitude (V)
0.0717
TOR VERGATA
RADIOSENSE
Running..
SYSTEM
STATUS
Measured
Magnetic field


Ritardo
35.6 [°C]
41.3 [°C]
28.9 [°C]
0.0717
TOR VERGATA
RADIOBENSE
PHILIPS

Take home messages

WIRELESS DATA ACQUISITION

Real-time data acquisition and visual processing through an ad-hoc designed dashboard

ON TIME ATTACK DETECTION

Real-time warning through magnetic field measurement

ANOMALY LOCALIZATION

Precise fault localization via wireless temperature sensors

Thanks for the attention!

Speaker:

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