



IoT Week Bilbao 2018

4-7 JUNE 2018, BILBAO (SPAIN)
EUSKALDUNA CONFERENCE CENTRE

INDUSTRIAL SOLUTIONS ON FARMING&FOOD SECURITY

ADVANCED SENSING FOR FOOD QUALITY

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IK4  TEKNIKER
Research Alliance

IoT•Forum





INTRO

Global trends and Market Requirements
are pushing the FOOD sector
towards a **new era**:

Cost efficiency at all levels (O&M, waste reduction, production)

Productivity and competitiveness

Sustainability

From community to individuals

Quality controls and worldwide regulations

Everything driven by Industry 4.0 and IoT paradigms

AGRI-FOOD & FARMING





BENEFITS OF ADVANCED SENSING

Regulations (safety, control of the production process)

Ensure **Quality**

- Prevention, minimize risks in a process
 - Composition
 - Along the whole chain
 - Final product aesthetics/category
-

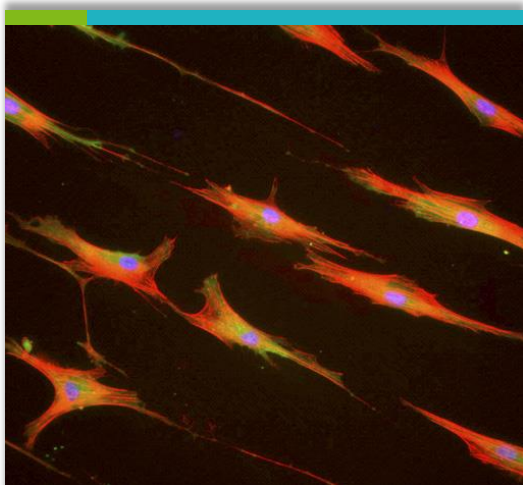
Brand, traceability, esteem

Product **valorization**

More and better **information** to make decisions

Sustainability, production optimization

ADVANCED SENSING: A CHALLENGING PROCESS



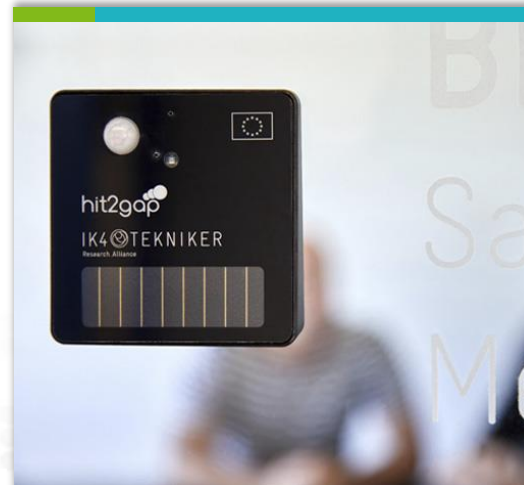
Principle

Electrochemical
Optics
2D/3D imaging
Fluorescence
Ultrasonic
...



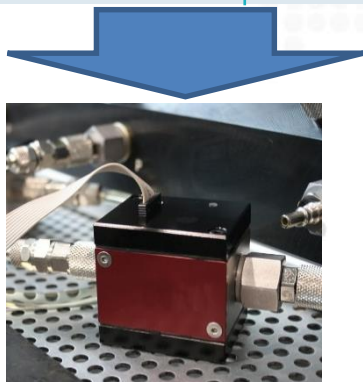
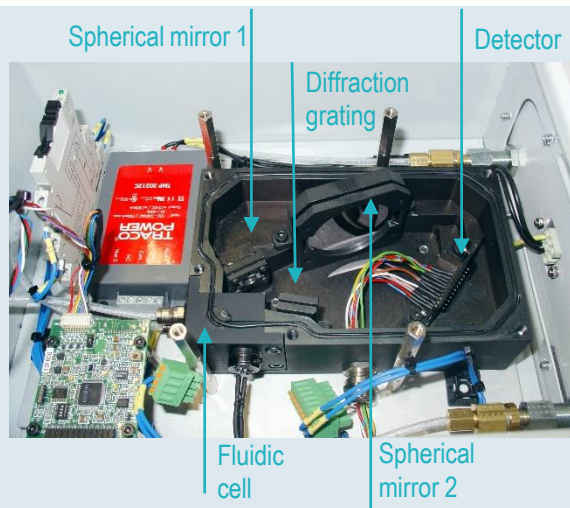
Detection method

Analytic chemistry
Spectroscopy
Microscopy
Colorimetry
Artificial vision
...



Integration

Electronics & Communications
COTS sensors
Mechanics and fluidics
Materials
Data processing and analytics
...



FROM LAB TO IN/ON-LINE

KEY PARAMETERS IN FOODS & BEVERAGES

Vis-NIR SPECTROSCOPY

FLUIDS

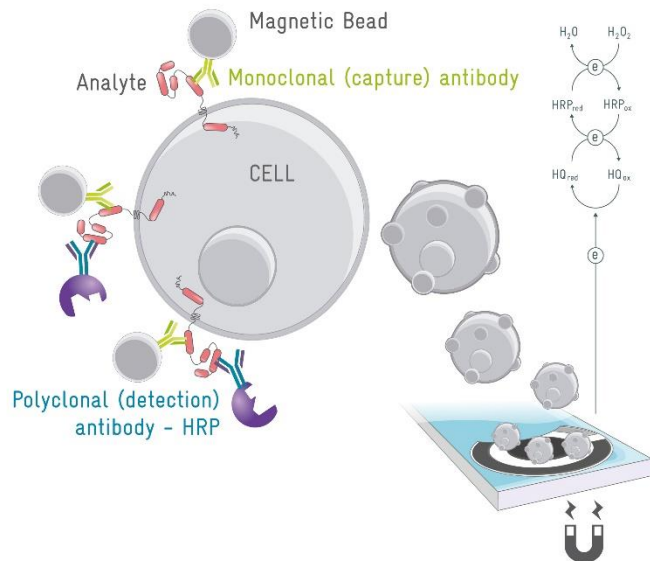
TRANSMITTANCE, ABSORBANCE

| | |
|-----------|----------------------|
| WINE | alcoholic grade |
| CIDER | alc, fructose, acids |
| MILK | fat content |
| OLIVE OIL | acidity |

SOLIDS

REFLECTANCE

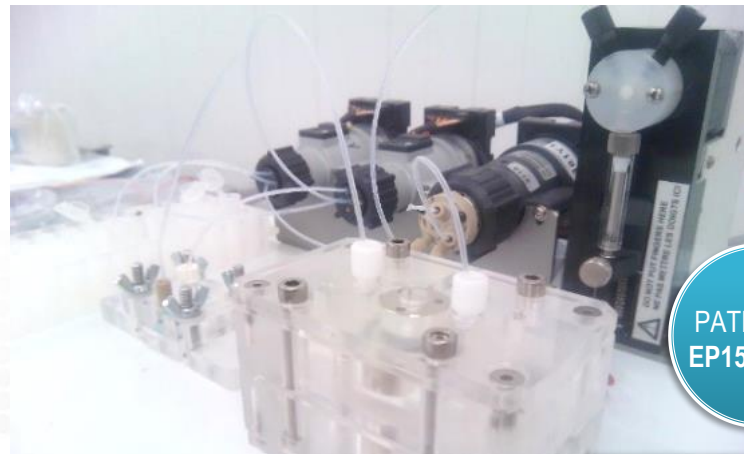
| | |
|--------|-------|
| FRUITS | %Brix |
| TOMATO | %Brix |
| NUTS | |



FROM LAB TO IN/ON-LINE

DETECTION OF ALLERGENS & PESTICIDES

ELECTROCHEMICAL DETECTION SYSTEM



PATENTED
EP15382066

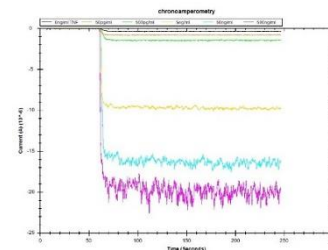
SAMPLE HOMOGENIZATION

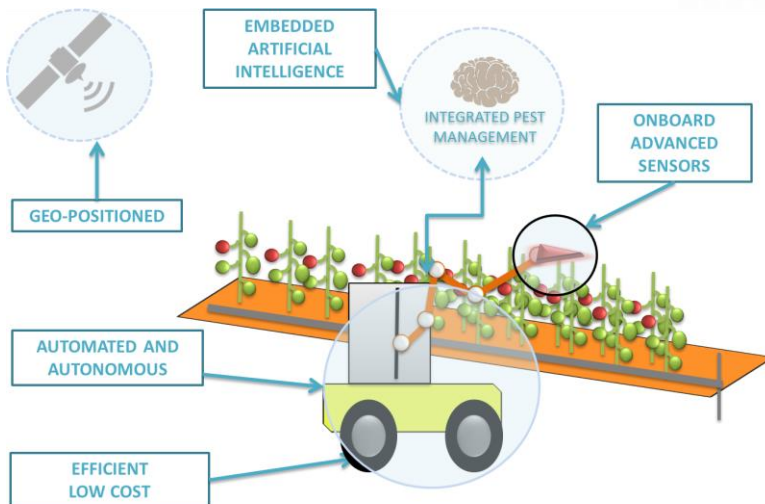
PROTEIN EXTRACTION

LIQUID-SOLID PHASE SEPARATION

EXAMPLE: DETECTION OF
TROPOMYOSINE
IN PRAWN EXTRACTS

Real samples
LOD < 1ppm





TOWARDS INDUSTRY 4.0 IN FARMING

NON-DESTRUCTIVE INSPECTION

FULLY AUTOMATED

2D/3D Imaging, IR, Multi-spectral

Product classification (shape, size, color, maturity...)

Defects in products

Composition (key parameters)

Deep Learning

Detection of pests and weeds in crops

Precision agriculture, site specific crop manag.,...



ENABLING BIG SCALE MONITORING

LOW COST DISTRIBUTED SENSING

WIRELESS AND EASY TO DEPLOY SOLUTIONS

- Integration of **low cost commercial sensors**
- **Wireless Sensor Networks and IoT** communication
- Ultra low power + **Energy Harvesting**
- **Plug, Play & Forget**
- Distributed **datalogging**
- **Cloud-based** advanced processing and analytics



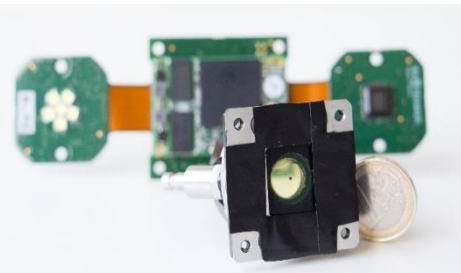
Welfare and **environmental** monitoring
(in farms, agriculture, retail, transportation)

Cold chain supervision and traceability

DEVELOPING ADVANCED SENSORS: THE PROCESS



ALIGNED WITH FOOD&FARM SECTOR NEEDS



Addressing a broad set of requirements:

- Compatibility with health and sanitation **regulations**
- **In-line** operation
- **Non-destructive** measurements
- **Robust** and **autonomous** devices
- **Cost** efficiency
- **Portable** and **highly integrated** solutions
- Sensitivity, precision and **reliability**
- **Connected** and **secured**

DEVELOPING ADVANCED SENSORS

SOME CASE STUDIES

Ad-HOC WineNIR



Functional prototype to monitor alcoholic grade during wine fermentation

- Transmittance NIR sensor (1750-2200nm)
- Temperature self-compensation
- Low cost
- Designed for an easy integration into wine barrels
- On-line measurement, remote sending of data for further storage and analysis.

Pre-validated comparing 8 different wines

Compatible with health and sanitation reqs.

Easy to use and operate



IN-LINE PARTICLE COUNTER



Advanced sensor for fluids

- Continuous measurement
- In-line microscopy
- In production for lubricant fluids
- Embedding CMOS sensor, optics and emitter
- In-device image processing and basic chemometrics
- IoT-ready for remote monitoring and control

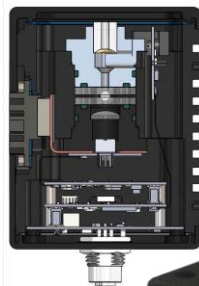
Applicability in FOOD

- Detection and classification of bubbles/solids (e.g. beer market)
- Proof of concept currently ongoing to monitor phytoplankton



NIR SOLUTIONS

WATER IN OIL

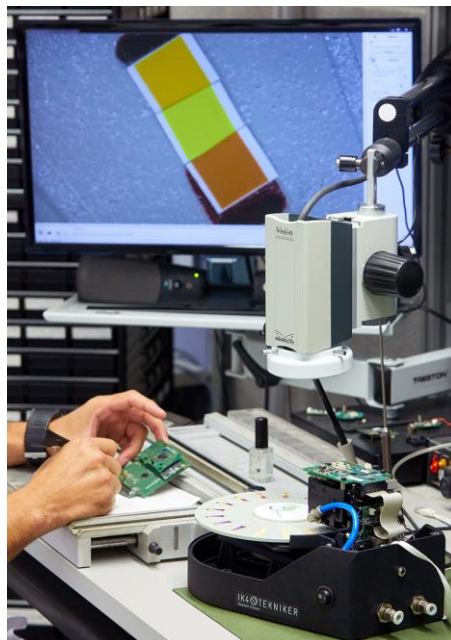


NUT SHORTING



COLOR SENSORS

AROMA IN FLUIDS



FLUID OXIDATION



SOME FINAL REMARKS

Advanced sensing is a MUST for food quality

Many direct and indirect advantages: safety, efficiency, production optimization and control, quality assurance, brand positioning,...

Complex process requiring a multidisciplinary team of experts

Validate a measurement principle

Functional prototype

Development up to product stage

Certification and qualification

Support during product lifetime

*“When you can measure what you are speaking about,
and express it in numbers, you know something about it”*

Lord Kelvin (1824-1907)



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