CAMERA DI COMMERCIO DELLE MARCHE

SENIOR

MARCHE LAND OF EXCELLENCE

REGIONE MARCHE

# MASTERSENSE

## Electronic Nose for the Detection of Food Freshness

# SENIOR SRL

Innovative startup founded in 2016 with the main goal of creating high-tech products and services. Senior has distinguished itself in these last years for creating highly innovative products in the field of sensor systems, implementing solutions that can be applied in different contexts

Senior is currently developing systems for the alimentary sector using portable devices equipped with chemical sensors

# TABLE OF CONTENTS



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# WHAT IS MASTERSENSE?

## ELECTRONIC NOSE

Instrument that includes a series of non-specific chemical sensors and a pattern recognition system capable of recognizing simple and complex odors




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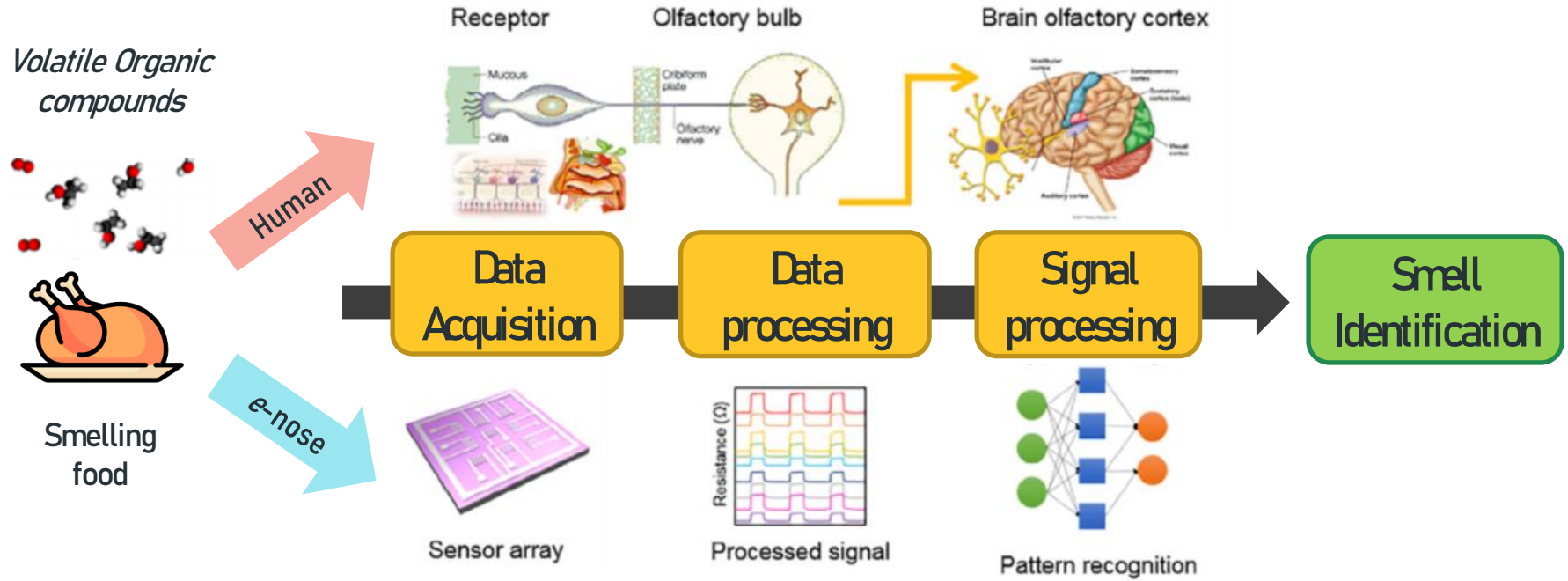
# HUMAN NOSE VS *E*-NOSE

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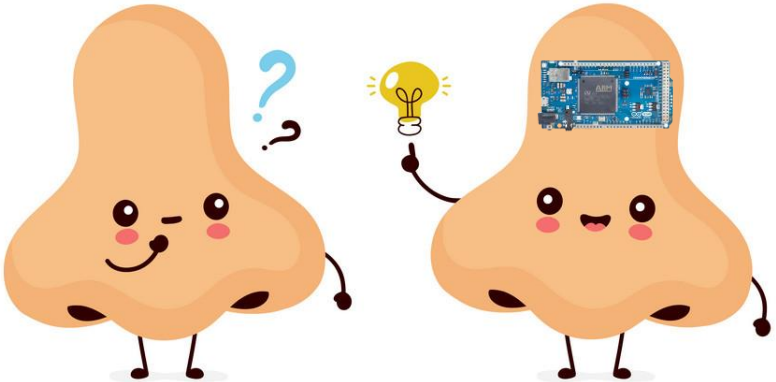
# WHY MASTERSENSE?

Humans are able to pick up around a trillion different fragrances...

**BUT**

Factors that limit human olfactory capabilities:

- Overlapping odour conditions
- Physical conditions that alter the sense of smell (long time exposure)
- Inability to perceive odours at very low concentrations



# WHAT DOES MASTERSENSE DO?

It is able to evaluate the safety and the freshness of food

It tells you if the food is:

# MASTERSENSE AIM

Internal routine quality controls → creation of reports

Great organized distribution (G.D.O.) and restaurants

## ADVANTAGES

- Certify the level of freshness and quality of food with analytical methods
- Select suppliers
- Monitor storage conditions
- Non-destructive analysis
- No cost for each analysis
- Easy to use
- Fast response time

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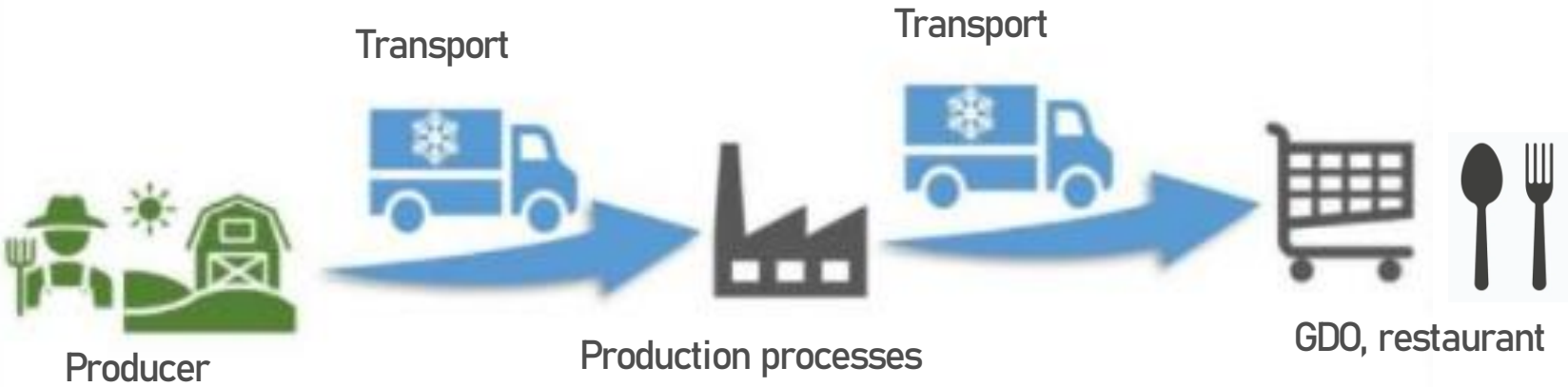
# OTHER APPLICATIONS

Currently other versions of the product are already being used for:

- Quality control → control of flour and added additives (replacing the human panel test)
- Packaging control → efficiency of packaging containment
- Ripeness control → peppers and apples ripening control

# AGRI-FOOD CHAIN




## MONITORING FOOD FRESHNESS FROM PRODUCER TO CONSUMER

Almost 20% of global food waste is caused by problems during the transportation phase

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# AGRI-FOOD CHAIN AND BLOCKCHAIN


Registry structured as a chain of blocks containing transactions and the consensus is distributed to all nodes in the network. All nodes can participate in the validation process of transactions to be included in the registry

- Decentralized
- Traceability
- Disintermediation

- Transparency and verifiability
- Register immutability
- Programmability of transfers

# FOOD WASTE

data taken from the UNEP Food Waste Index Report 2021

Around 30% of the food produced for human consumption worldwide is destroyed or thrown away each year

931 million tons of food waste were generated in 2019

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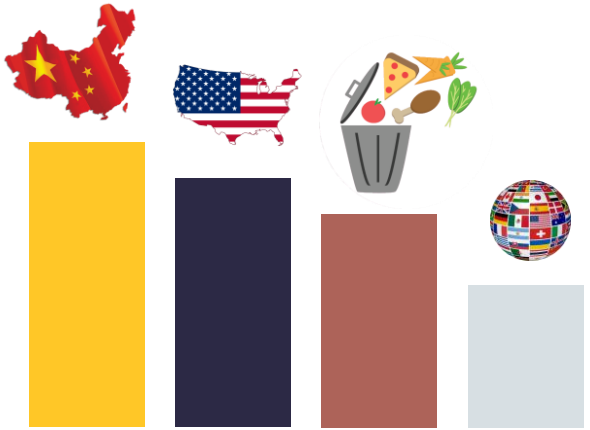
# ENVIRONMENTAL IMPACT

- Food waste alone = 8-10% of global greenhouse gas emissions
- 20% of the carbon footprint of total food waste comes from meat
- If food waste were a country, it would be the third biggest emitting country in the world



# FOOD SAFETY

In 2019, during the 73rd session of the United Nations General Assembly (UNGA) held in New York, the World Food Safety Day was proclaimed

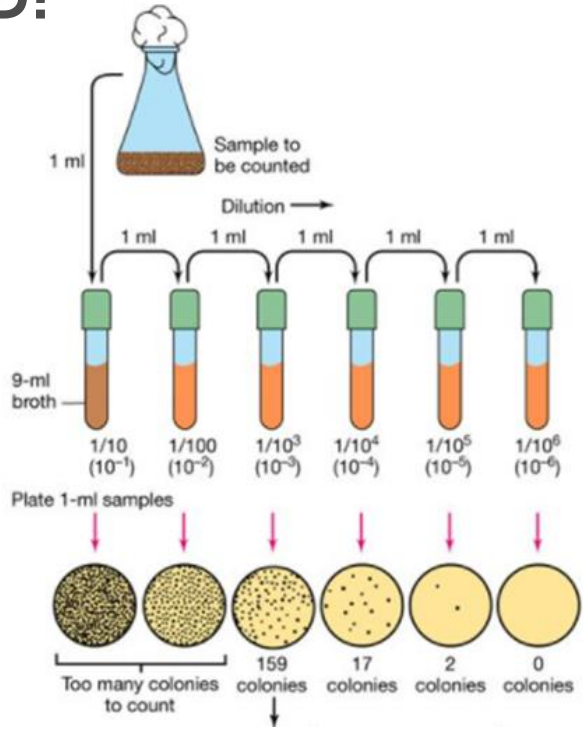

Food safety means safe food at every stage of the food chain, from the field to the table

# HOW IS FOOD SAFETY CONTROLLED?

## MICROBIOLOGICAL ANALYSIS
## TVC (TOTAL VIABLE COUNT)

UNI EN ISO 4833-1: 2013

- Dilution of the food sample
- Sample is placed in non-selective culture medium, PCA (Plate Count Agar)
- Wait for incubation time: 72 hours at 30°C
- Count of colonies

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# HOW IS THE ANALYSIS WITH MASTERSENSE MADE?

- Place the food sample in the glassware
- Start the software and the measure
- Wait few minutes
- Read the result

# COMPARISON BETWEEN TVC AND MASTERSENSE

| | TVC | MASTERSENSE |
|---|---|---|
| PLACE | laboratory | everywhere (portable device) |
| EXECUTION TIME | more than 72 h | few minutes |
| OPERATORS | specialized | not specialized |
| MATERIALS | solvents, PCA... | / |
| COSTS | each analysis | / |
| ANALYSIS | destructive | non-destructive |

# PRESENT CONTEXT

## ANOSMIA

It's the loss of the sense of smell

- Affects around 80% of patients
- Not only temporary for some people

MASTERSENSE could improve the safety and quality of life of these people

# SCIENTIFIC RESEARCH: PUBLICATION

sensors

MDPI

UNIVERSITÀ DEGLI STUDI DI MILANO
DIPARTIMENTO DI SCIENZE PER GLI ALIMENTI, LA NUTRIZIONE E L'AMBIENTE

*Article*

## Meat and Fish Freshness Assessment by a Portable and Simplified Electronic Nose System (Mastersense)

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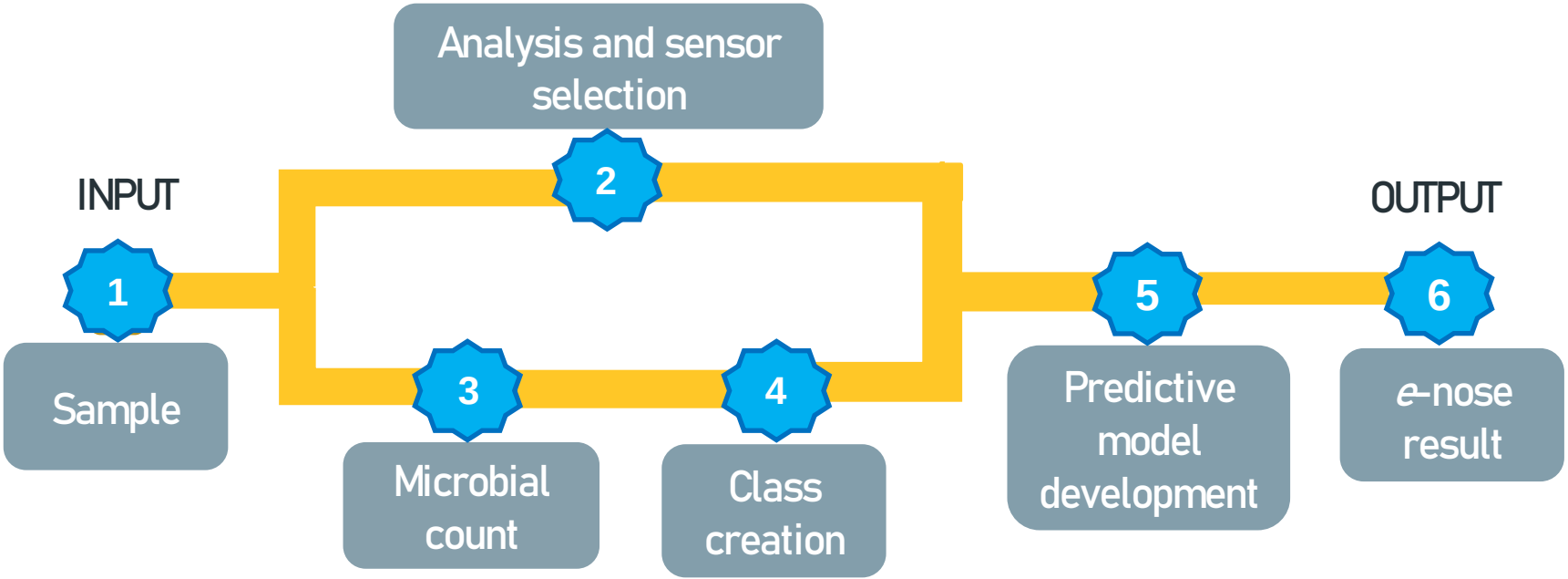
# RESEARCH WORK: THE STEPS

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# RESEARCH WORK: SAMPLING

## 1 Food matrix selected

Beef

Chicken

Salmon

Plaice

The analyses were conducted in different times

day of packaging

expiry date

*timeline*

** University analysed other fish with the same results*

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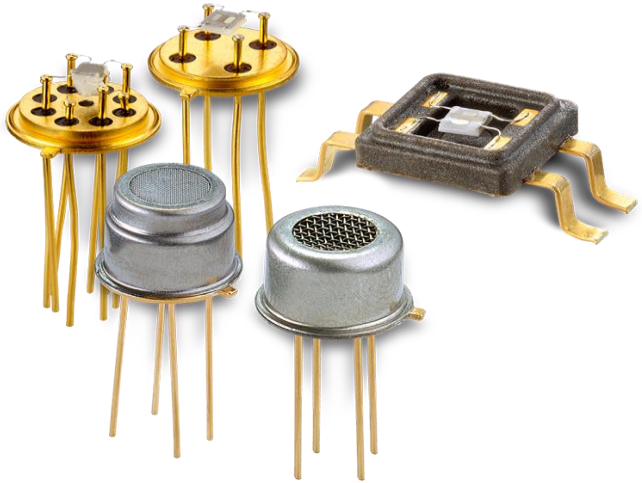
# RESEARCH WORK: ANALYSIS AND SENSORS SELECTION

2

## MOS (METAL OXIDE SEMICONDUCTOR)



- Robustness (related to their manufacturing process) and durability (more than 10 years)
- Good resistance to gas corrosion and humidity
- Good sensitivity to volatile compounds
- Rapid response
- Linear concentration response (more than other sensors)

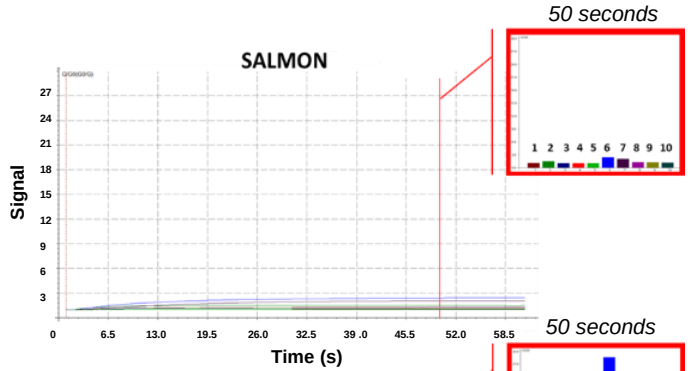
# RESEARCH WORK: ANALYSIS AND SENSOR SELECTION

2

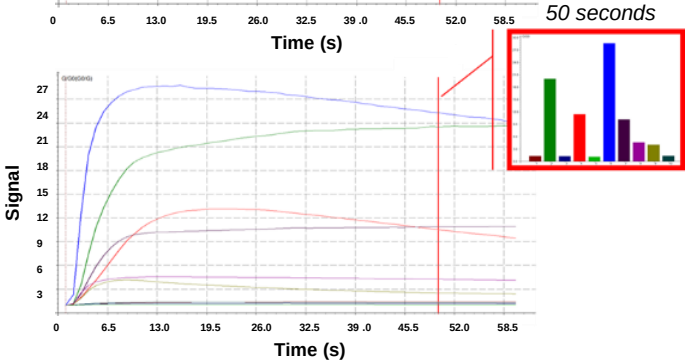
10 MOS TESTED

4 MOS SELECTED

day of packaging




expiry date

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# RESEARCH WORK: MICROBIAL COUNT

3

## MICROBIOLOGICAL TESTING ON FOOD SAMPLES FOR TOTAL VIABLE COUNT (TVC)

# RESEARCH WORK: CLASS CREATION

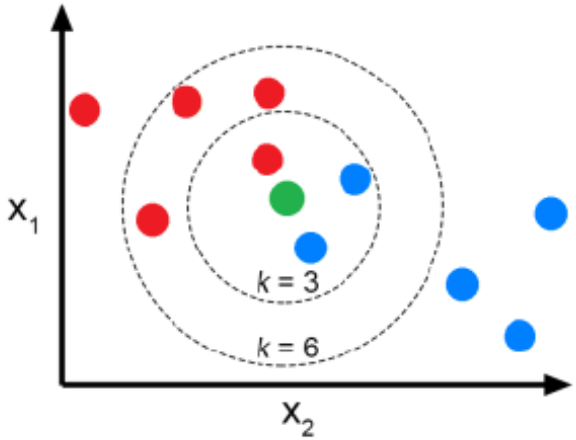
4

## DEFINITION OF FRESHNESS CLASSES: CORRELATION BETWEEN BACTERIAL COUNT (UFC/g) VS. CLASSIFICATION

| |  |  |  |  |
|---|---|---|---|---|
| FRESH | $\leq 10^6$ | $\leq 10^6$ | $\leq 3 \times 10^6$ | $\leq 1.5 \times 10^6$ |
| ACCETTABLE | $10^6 < x \leq 10^7$ | $10^6 < x \leq 1.2 \times 10^7$ | $3 \times 10^6 < x \leq 5 \times 10^7$ | $1.5 \times 10^6 < x \leq 5 \times 10^7$ |
| SPOILED | $10^6 < x \leq 10^7$ | $10^6 < x \leq 1.2 \times 10^7$ | $3 \times 10^6 < x \leq 5 \times 10^7$ | $1.5 \times 10^6 < x \leq 5 \times 10^7$ |

# RESEARCH WORK: PREDICTIVE MODEL DEVELOPMENT

5




## CLASSIFICATION MODELS

### TESTED

- K-nearest neighbours' algorithm (k-NN)
- Partial least square-discriminant analysis (PLS-DA)

### IN PROGRESS

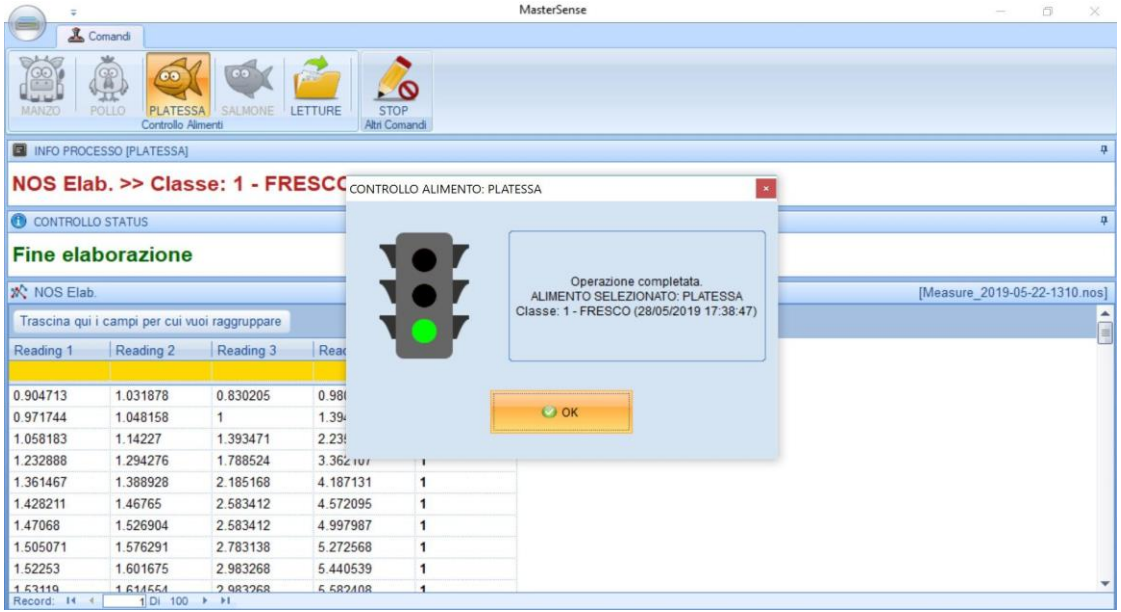
- k-NN quantum algorithms
- Deep Learning (Food matrix extension)

# RESEARCH WORK: E-NOSE RESULT

6

## DEVELOPMENT OF ACQUISITION MODE:

- CLOUD PLATFORM

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# FURTHER DEVELOPMENTS

6

DEVELOPMENT OF ACQUISITION MODE:

- MOBILE APP




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# UPCOMING STEPS

Implementation of graphic interface

The freshness class will be guessed from the gestures and facial expressions of a metahuman

# SUMMING UP

OUR TEAM
different
fields
expertise

Safety
and
Quality


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# MASTERSENSE ACHIEVED OBJECTIVES

- ✓ Fast measurements (few minutes)
- ✓ Easy to use (intuitive programming and few operational steps)
- ✓ Portable device
- ✓ Non-destructive analysis
- ✓ Analytical measurements (easy to understand)
- ✓ Inability to act on results
- ✓ Possibility of immediate sending of results to the management server
- ✓ Cost per analysis equivalent to zero
- ✓ Low cost operation and maintenance

# THANK YOU
# FOR YOUR ATTENTION

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