# GALA - Integrated Environment Management System in dairy barns to improve the welfare and productivity of the cows

## Aim of the project

The project aims to create a management system for the housing environment in the dairy farm by integrating the various information (microclimatic, non-climatic, behavioral, production, food, management) in order to provide:

- elements for the automatic control of some devices;
- signaling to the breeder situationsanomalous or requiring his intervention;
- monitoring of environmental parameters inside the barn;
- indications for a better management and to improve environmental conditions.

## Why a monitoring system for dairy farms?

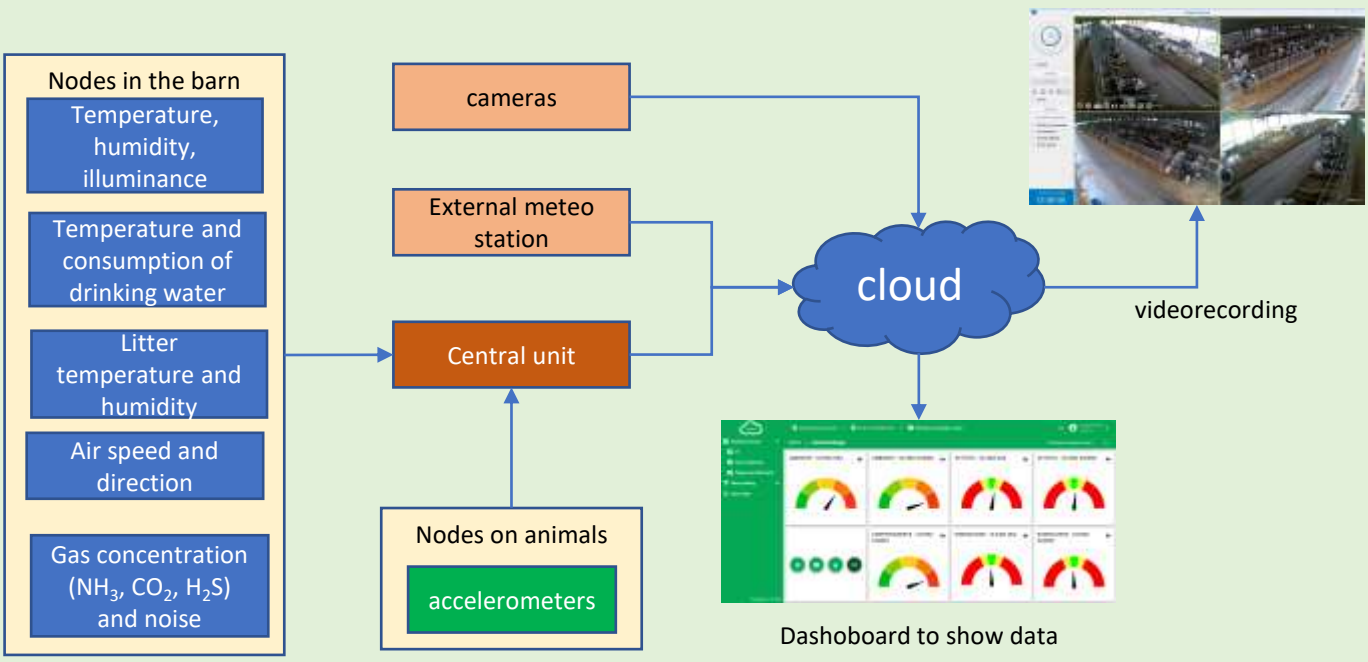
Even in the most computerized and automated farms (for example with milking robot), few environmental data are collected and used. Even when there are sensors to detect the environmental conditions inside the barn and the behavior of the cows, the data are not integrated and used to get answers on the trend in the barn. The project GALA aims to fill this gap by developing a continuous monitoring system of environmental parameters and cow behavior to directly and indirectly control the barn environment, in order to create an environment suitable for life, production and to the reproduction of the cows reared in the structure also mitigating the internal climate.

## Integration of environmental data with cow behavior

The environmental conditions inside the barn influence the behavior of the cows. In particular, they can affect:

- how long they eat
- how long they rest
- how long they ruminate

To monitor these parameters, a collar with an accelerometer is used. Cow behaviors are then integrated with environmental data to give an overview of the barn conditions




The nodes installed in the barn consist of a microprocessor and a connection circuit with the various sensors. Each node carries out an initial processing of the data and sends the information to the barn control unit every 10 minutes. This in turn sends the data over the internet to a server which organizes them in a database that can be queried by a computer or smartphone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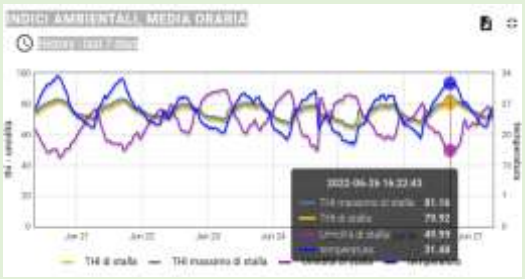
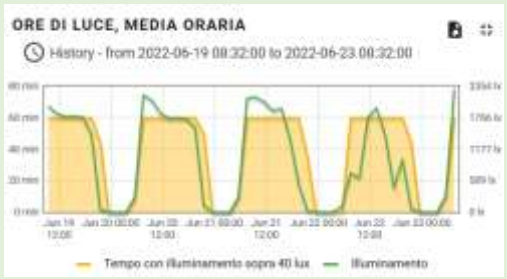
## The devices of the integrated management system

### Temperature, humidity, illuminance

In the barn there are 8 sensors that detect these parameters. Four of these also measure the radiant temperature. The temperature and humidity data are used to determine the THI index. The node is battery powered and transmits data via radio to the central unit.




The collected data can be viewed in the dashboard with different levels of detail. For example, by combining environmental indices or by calculating the hours of daylight per day.

### Air quality, noise

The node for monitoring air quality consists of sensors to measure the concentration of ammonia, carbon dioxide, hydrogen sulphide. In addition, the noise level in the barn is recorded. There are two such nodes in each barn. They must be powered by the net because the consumption of these sensors is high. Data is transmitted via radio to the central unit.


a


b

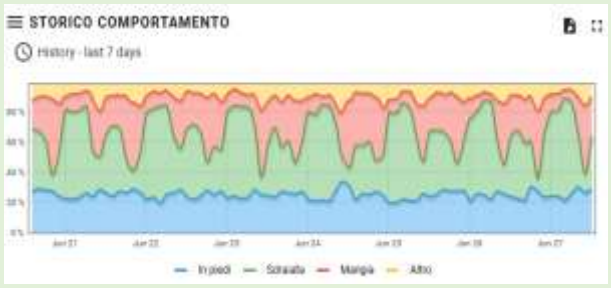

c


d


e

### Air velocity, water volumes, temperature and humidity of the litter

Each of these parameters is detected by special sensors. A cup anemometer (a) is used for the air velocity. The consumptions of drinking and cooling water are measured with a water counter equipped with a pulse-throwing device (b). A sensor normally used for the soil was used for the litter in the stalls (c). All sensors are connected to a node (d) which transmits the information to the barn control unit (e).



### Accelerometers for cow behavior monitoring

An accelerometer was created to be mounted on the animal's neck that allows you to monitor the accelerations on the three axes with a frequency of 25 Hz. Every 10 minutes the microprocessor inside the node processes the data and determines the behavior of the cow in that period. The data is sent to the barn control unit.
The information obtained makes it possible to evaluate the behavior of the herd and individual cows in relation to the environmental conditions of the barn.

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