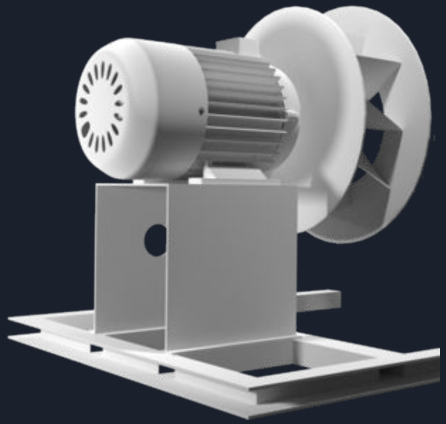
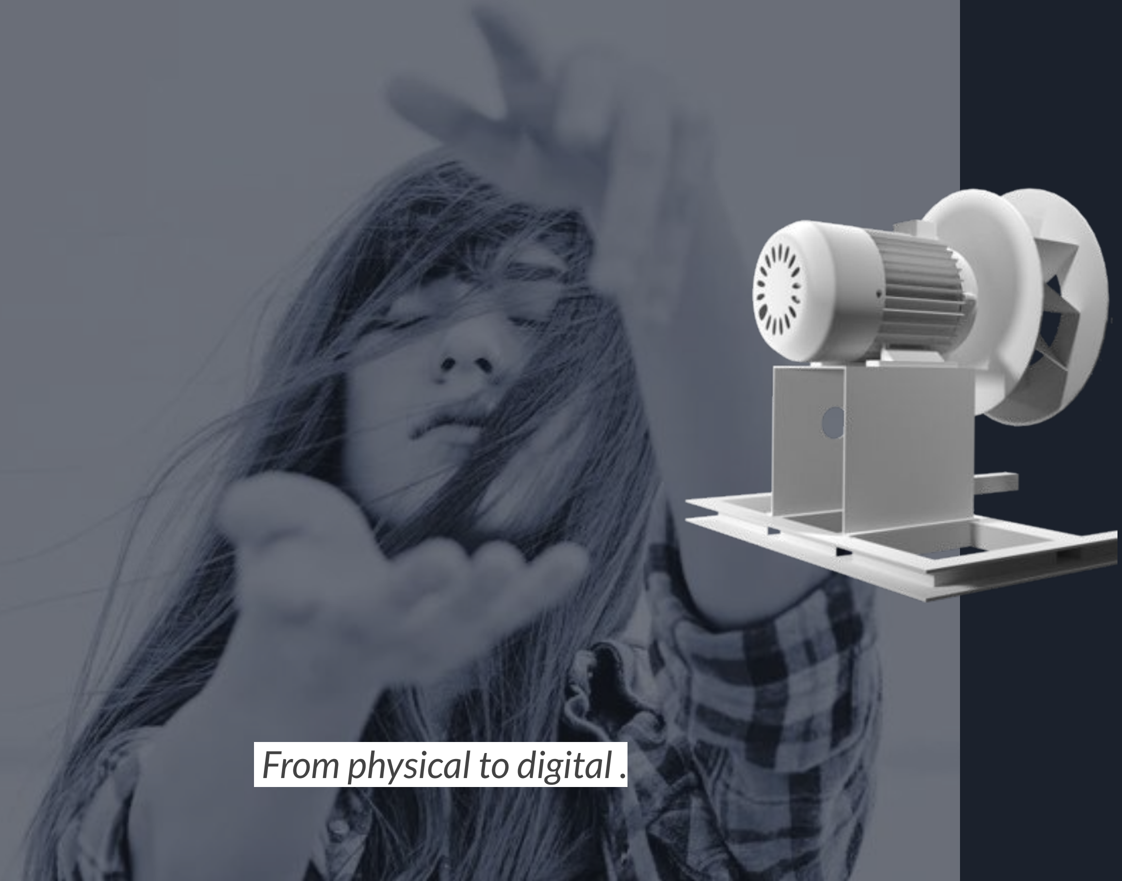
KURNUP

WE HELP FACTORIES STAY RUNNING

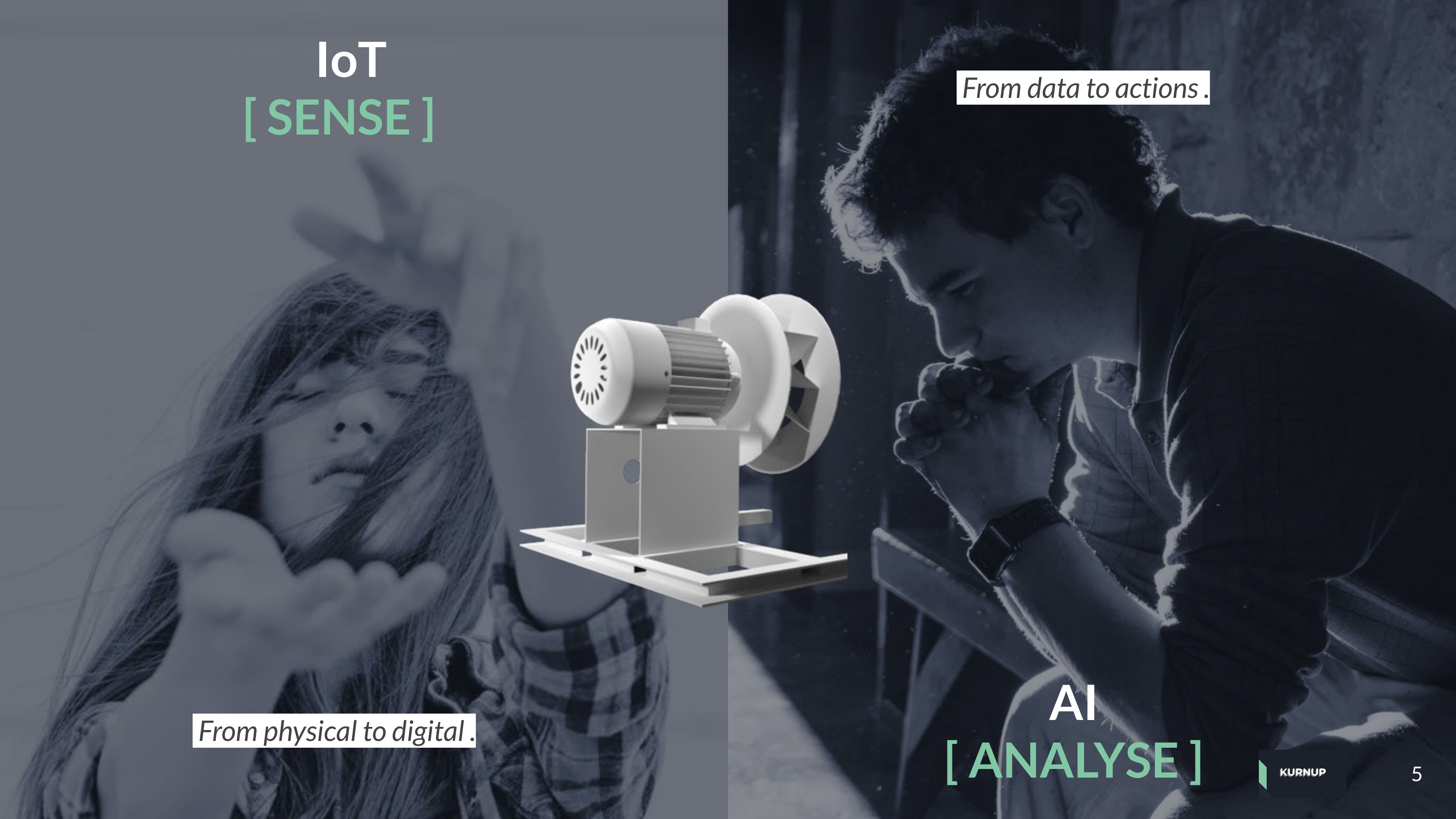
AIoT ?!



IoT
[SENSE]



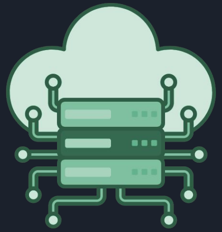
From physical to digital .


IoT
[SENSE]
From physical to digital .
From data to actions .
AI
[ANALYSE]

I. IoT for data acquisition

The three pillars of IoT

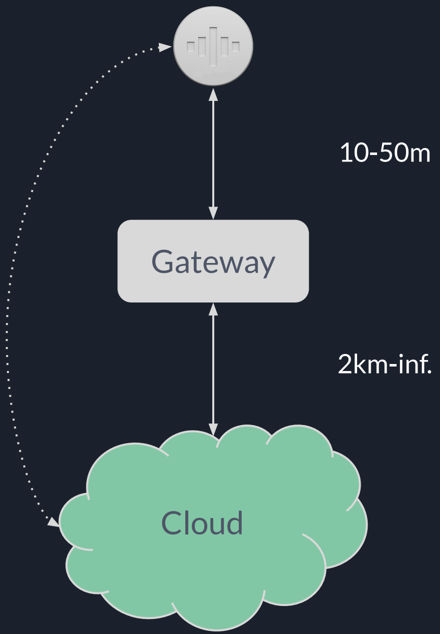
1. **Sensors**
2. **Network**
3. **Backend**



1 - Sensors
Type of sensors

- **Type of sensors?**
  - Vibration, temperature, sounds, pressure, humidity, etc.
- **Invasive?**
  - Invasive sensor versus exogenous?
- **Standalone?**
  - Does it require power source?
  - How long is the battery?
  - How easy is to change the battery?
- **Signal treatment or raw signal?**
  - Is there signal transformation already embedded in the sensor?
  - Has the chip controlling signal treatment to be programmed?
- **Frequency of measures?**
  - How frequent do you measure the data?
  - Data sampling?
  - How frequent do you send it to the cloud?


2 - Network

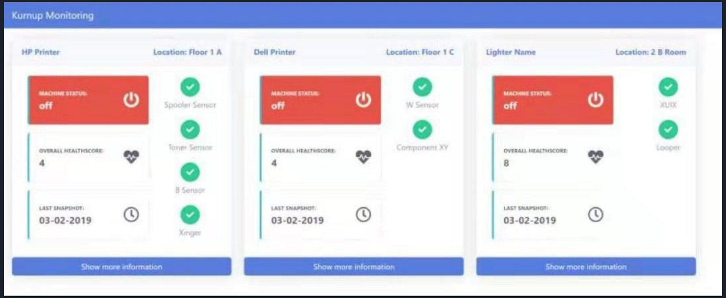


- BLE
- Zigbee

- LoRa
- Sigfox
- 4G
- Wifi
- ...

3 - Backend

- **Public/Private Cloud**
  - Where is the data held?
- **Web application/Mobile application**
  - Who are the users?
  - How do they access the information?
- **Data analysis & visualization**
  - What do you want to get from the data?
  - What do you want to achieve?
- **Intelligence**
  - Do answers come from the data?
  - Do you need humans to train it?
- **Alerting**
  - What triggers an alert?
- **Actions**
  - What follows an alert?



II. Data processing

What do you want to achieve?

- Production monitoring
- Inventory management
- Enhanced safety
- Quality control
- Production optimization
- Predictive Maintenance
  - Prevent from downtime
  - Spot which part will fail

Maintenance in the Industry 4.0 Era

Preventive Maintenance

Conditional Maintenance

Predictive Maintenance

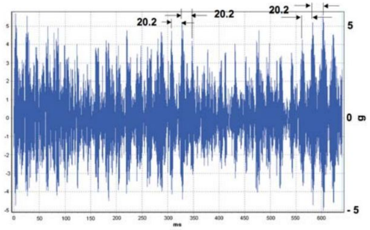
Towards predictive maintenance

Conditional based modeling

Feature selection

On which data would you put your thresholds?

What do you measure, what is the data stream you track? Which points do you extract from the data?



Alerting levels

How do you set up the levels of the thresholds?

What is the condition that triggers an alert?

Machine specific levels versus absolute levels (even identical machines can have different system properties)

III. Data Science and AI to the rescue

Levels of Predictive Maintenance

1. Detection
2. Diagnosis
3. Prognosis

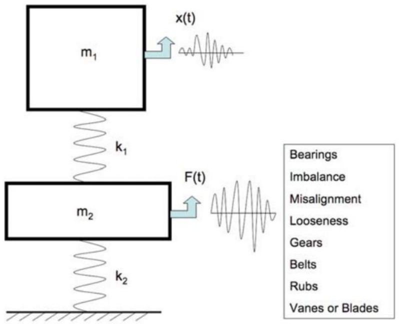
Our use case
Rotating machines

Equipment

Focus on rotating machines

Measures

Focus on vibrations

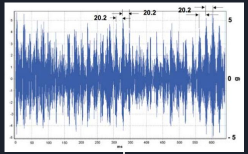


1 - Detection

Identify a defect

- <u>Feature selection:</u> extensive knowledge exists for vibrations (RMS, Crest Factor, max vibration amplitude, etc.)
- <u>Thresholds selection:</u> look at the drift from a ‘normal behaviour’ and set alerts based on the anomaly percentage
    - Thresholds are based on past data and/or knowledge
- Humans have the decision power

RMS
Crest factor
Max vibration amplitude
Peak frequency



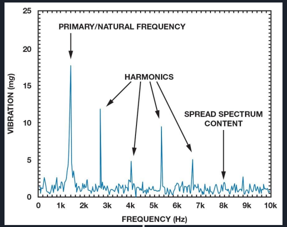
Health score: trend analysis

2 - Diagnosis

Find the source of a fault

- <u>Feature selection:</u> extensive knowledge exists from the Physics based on raw data transformation (vibrations signature: frequencies)
- <u>Fault categorization:</u> needs labeled data and/or human intelligence from past studies

Vibrations signature



- Bearing deterioration/damage
- Unbalance
- Misalignment etc.

3 - Prognosis

When will the machine fail?

- Estimation: needs past data to train the algorithm. Few failures data points are available but it can also be trained based on historical anomalies record.

Historical dataset

Time to failure estimation: what is the probability to reach this degraded health score in x days?

IV. Real life example

Project scope

1

Sensors

Project scope

1 Sensors

2 Network

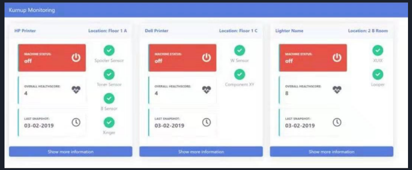
BLE + LoRaWAN

Project scope

1 Sensors

2 Network

3 Backend



Project scope

1 Sensors

2 Network

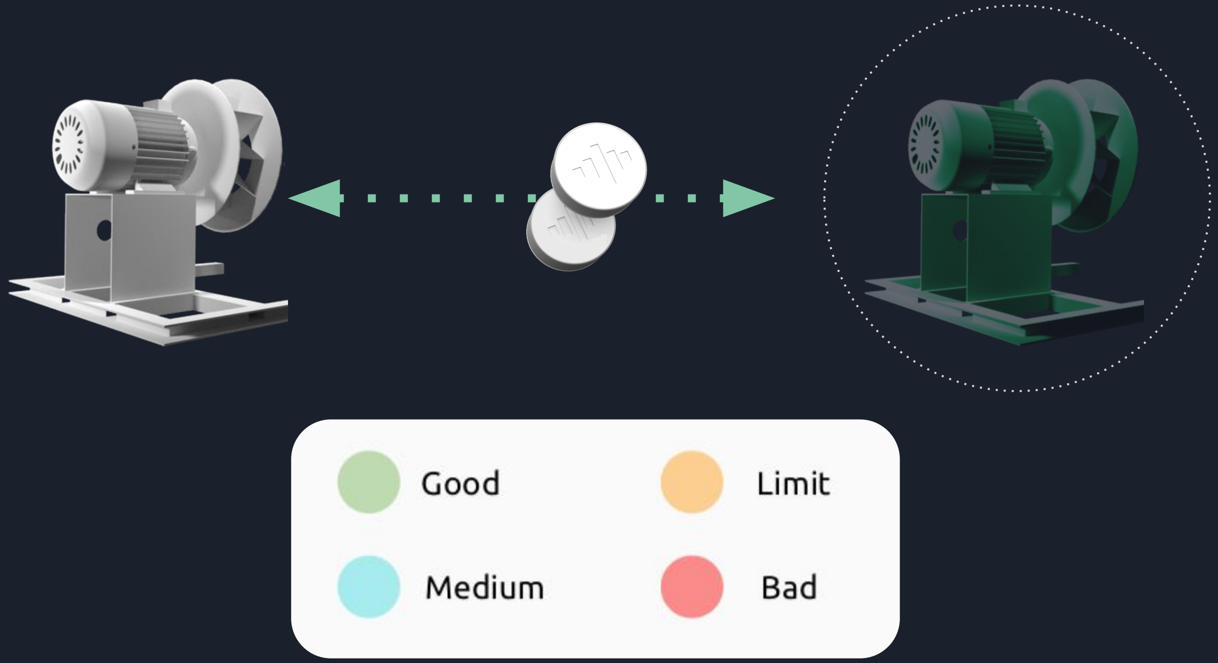
3 Backend

1 Detection

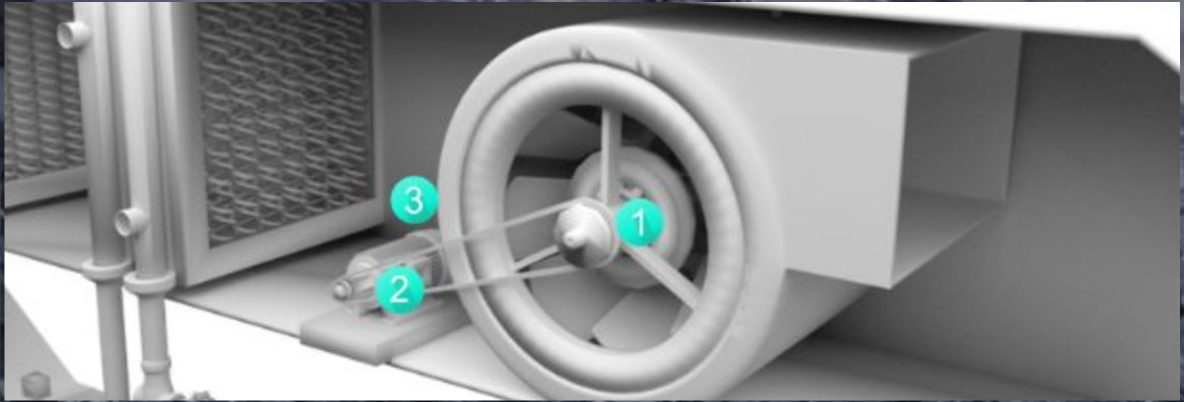
2 Diagnosis

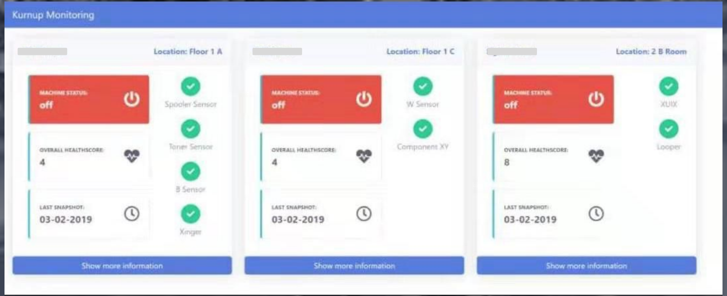
3 Prognosis

The detection model



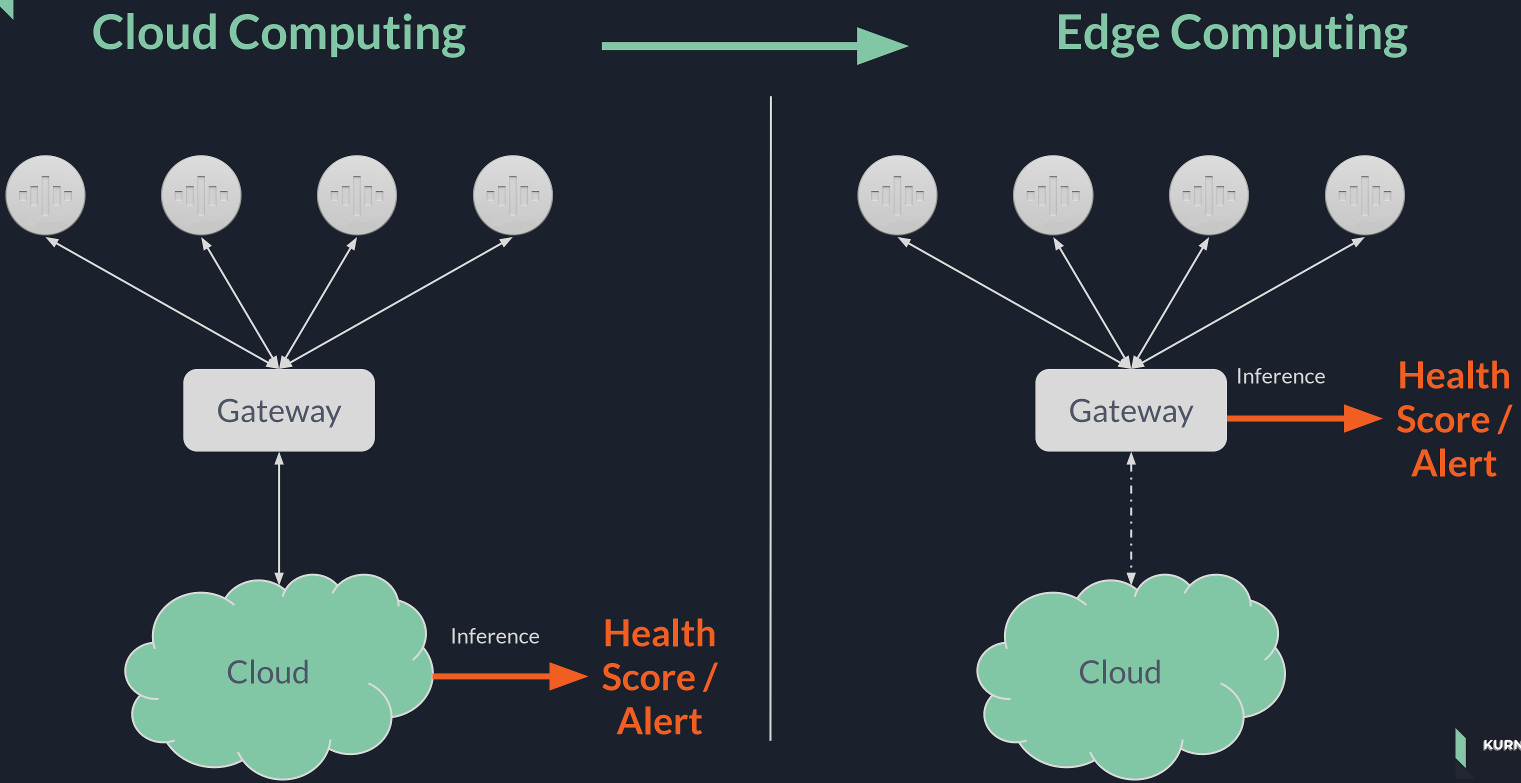
Air treatment use case





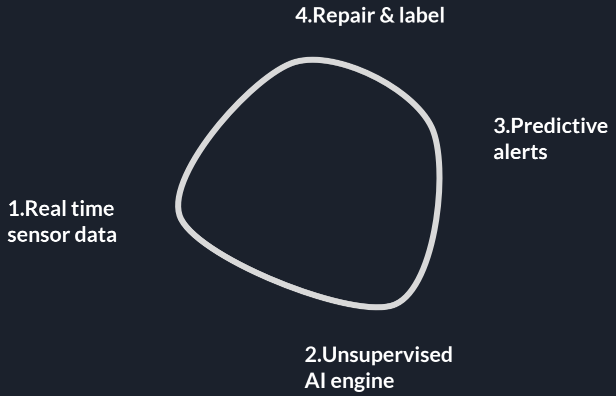
V. Industry trends

Edge computing
Towards local inference



Hardware as a Service
& AutoML

1. Collect Historical data
2. Run AutoML to select the best Machine Learning model



KURNUP

LET'S TALK!

Pierre Angot
CEO

Pierre@kurnup.com