Digitalization and Electricity Monitoring

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9 December 2021
Profile

• Researcher
  • Motor system energy efficiency
  • Appliance energy efficiency standards and labels
  • Cooling efficiency
  • Industrial IoT standardization

• **Programmer**
  • Embedded device and system
  • IoT cloud OPC UA server
  • Web application
  • Web crawling

• Coordinator
  • International cooperation
  • Technology transfer
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Why digitalization? - benefits

1. Reduces costs
2. Decentralizes production
3. **Enhances efficiency and productivity**
4. Creates new business opportunities
5. Accelerates reaction to demand trends
6. Fosters competitive advantage
7. Stimulates innovation against disruption
8. Boosts internal cohesion
9. Improves use of data capacity
10. Bring new talent’s interest
Why digitalization? - benefits

- Shorter setup and changeover times
- Reduced energy consumption
- Increased manufacturing productivity
- Reduced downtime
- Improved product quality
- Reduced waste
- Improved planning and forecasting
- Reduced inventory holding
- Improved time to market
- Improved competitive capabilities
- Improved financial sustainability
Why digitalization? – benefits for motor systems

1. Improve efficiency
2. Energy performance audit
3. Predictive maintenance
4. System re-design & re-size
What is digitalization? – terms and definitions

- **Digitalization** is the process in which aspects of social life are restructured around digital communication.

- **Digitization** is the process of converting information into a digital (i.e. computer-readable) format. The result is the representation of an **object**, image, sound, document or **signal** (usually an analog signal) by generating a series of numbers that describe a discrete set of points or samples.

- **Digital Transformation**: refers to a company adopting a digital technology.
What do we want to sense?

• Environment
  • Air quality: PM2.5, PM10, air pressure, NOx, SOx, O₃, CO₂
  • Water quality: BOD, COD, turbidity
  • Temperature & humidity
  • Hazardous gas: TVOC, CH₂O, etc
  • Soil: wetness, turbidity

• Energy
  • Electricity: power, voltage, current, power factor
  • Liquid: quantity, velocity, pressure
  • Air flow: quantity, velocity, pressure

• Others
  • Rotating speed
  • Vibration
  • Lighting brightness
  • Thermal
What do we want to control?

• Operation on and off
  • Motor
  • Power system

• Speed
  • Voltage and current
  • Frequency

• Status
  • Valve opening rate
  • Damper opening rate
  • System operation configuration
How do we sense and control?

- Sensor
- Sensor & Actuator
- Actuator
- Controller or gateway
- Remote or cloud controller
Level 1 sense: traditional meters
Level 2 sense: digital meters
Level 3 sense: external digital meter
Case: pump system operation
Case: air compressor system operation
Level 4 sense: sample, show and transmission

Smart sensors and meters

VFD

Flow

Pressure

Power

Data gateway

Cloud Server

OPC UA Protocol

Graphical, dynamical clients
Innovative sensors
Case 1: house toxic gas monitoring
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Case 1: house toxic gas monitoring
Case 2: smart pump demonstrator
Case 2: smart pump demonstrator

- Gateway
- Modbus hub
- Flow meter type II
- ABB VFDs
- Flow meter type I
- Pressure meter
Case 2: smart pump demonstrator

Gateway with screen

Gateway connects to Modbus hub
Case 3: Electricity monitoring
Smart socket
Total house energy stats

- Total power consumption: 10,483,443 kWh
- Average power: 437.1 W
- Period: 23.98 hours, 1,439 minutes

Select stats period:
- Start: 2021/12/3 17:55
- End: 2021/12/4 17:55
- Interval: 1 minute

Power stats chart showing power consumption over time.
Refrigerator power stats

- Total power consumption: 0.7983kWh
- Average power: 33.3W
- Period: 23.99 Hours, 1439 Minutes
TV power stats

0.6847kWh
Total power consumption

28.5W
Average power

23.99 Hours, 1439 Minutes
Period

Select stats period

Start: 2021/12/3 17:57
End: 2021/12/4 17:57
Interval (mins): 1
1 Hour
6 Hours
24 Hours
Analyze

Socket stats

Power (W)

Status

Time

0
20:00
24:00
4:00
8:00
12:00
16:00

0
0.2
0.4
0.6
0.8
1

130
120
110
100
90
80
70
60
50
40
30
20
10
0
Environment stats - Temperature
Smart watering
How to start? - Arduino

https://www.arduino.cc/
Disadvantage of digitalization

• Extra development and deployment cost
• Extra system maintenance cost
• Engineering training and using
• How to extra the knowledge from the data?
Thank You!

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