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Leverage from the EU 2014–2020

European Union
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Experimenting with means to Store and Monitor IoT based Measurement Results for Energy Savings

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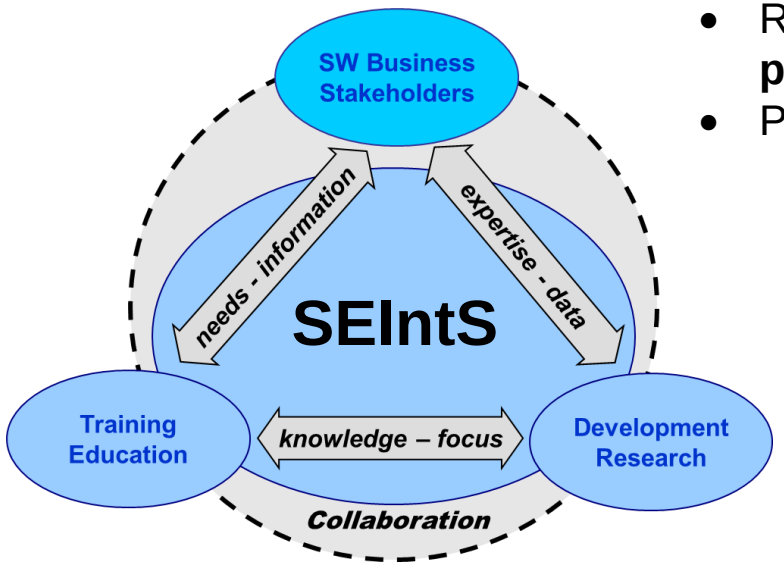


- Research staff: **15 persons**
- Project volume: **1 M€**

- Global software engineering
- Software business
- Software engineering management
- Software and **application architectures**
- Web services and user interface techniques
- Mobile and web applications
- **Smart systems and intelligent spaces**
- **Sensors and sensor networks**
- Embedded systems and **IoT**
- Green ICT

Research Context

- **IoT Prototype development**
- Software orientation
- Utilization of **off-the-shelf devices**
  - smartphones and tablets
  - Arduino, Raspberry Pi, Beagle Bone, Intel Galileo, etc.
  - Sensors (heat, humidity, pressure, movement, position, etc.)

IoT-Prototypes produce large amount of sensor data

Our Paper – Store and Monitor data

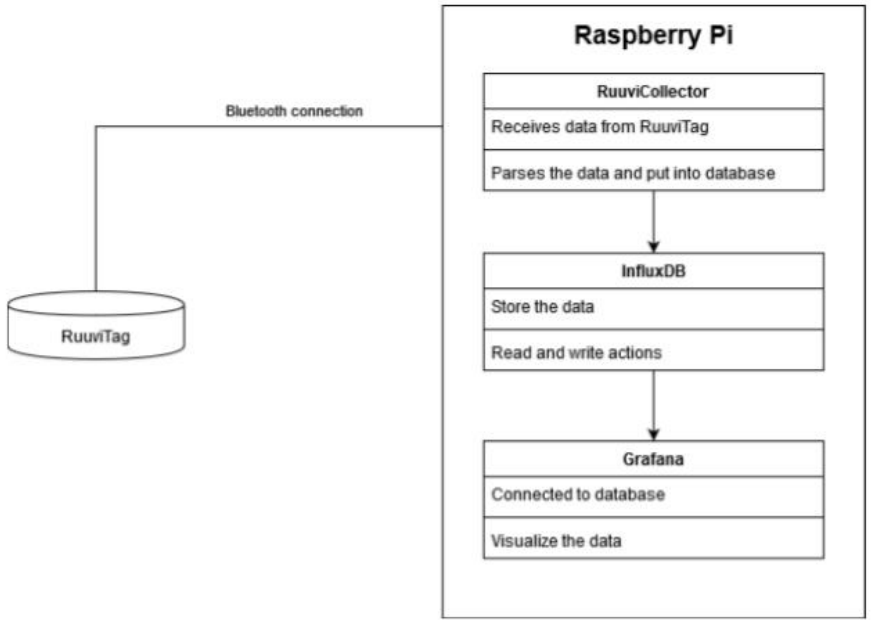
Three different test scenarios to store, monitor and visualize data

1. RuuviTAG with a time series database.
   - Temperature, relative air humidity, air pressure and motion information
2. Data gathering system with a cloud-based document database
   - Temperature sensors, Arduino and Raspberry
3. Embedded relational database prototype system.
   - Self made sensor device packages: Temperature, Humidity, CO2, Arduino, Raspberry

1. RuuviTag with time series database

Collects data with RuuviTags and send data to Raspberry Pi:

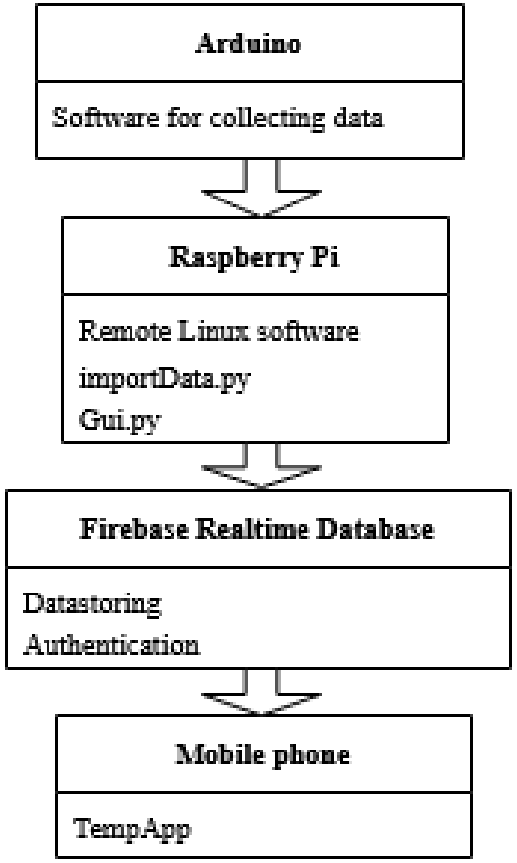
- Devices
  - RuuviTags : “RuuviTag is a generic sensor node, that fits perfectly with many uses. Its **open-source** design enables various customisation possibilities. Both the hardware and software are 100% **open**.” [ruuvi.com]
  - Raspberry Pi
- Software
  - RuuviCollector – collect data from ruuviTags
  - InfluxDB – Timeseries database to store data
  - Grafana – Visualize data

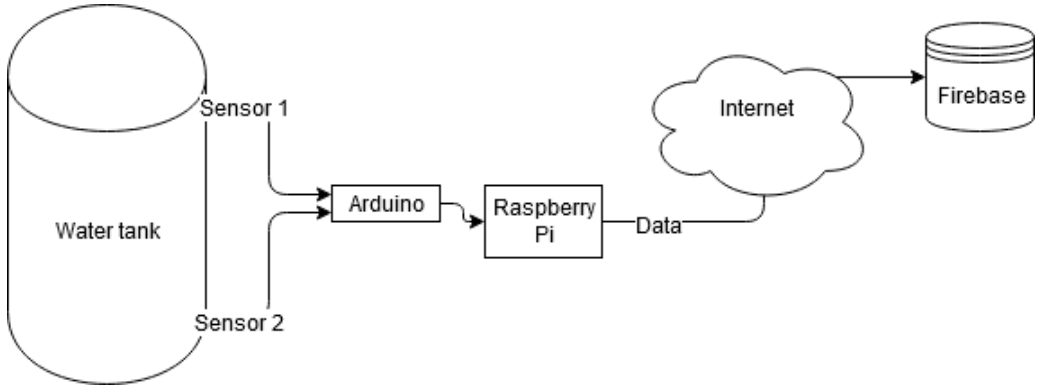


2. Cloud-based document database

Temperature sensors with Arduino sends data via Raspberry Pi to Firebase Cloud

- Devices
  - Temperature sensors
  - Arduino
  - Raspberry Pi
- Software
  - Arduino application use sensors and send data
  - Raspberry Pi reads data and send data to cloud
  - Firebase cloud storage store data and offer it to users
  - Mobile application for provide information to users





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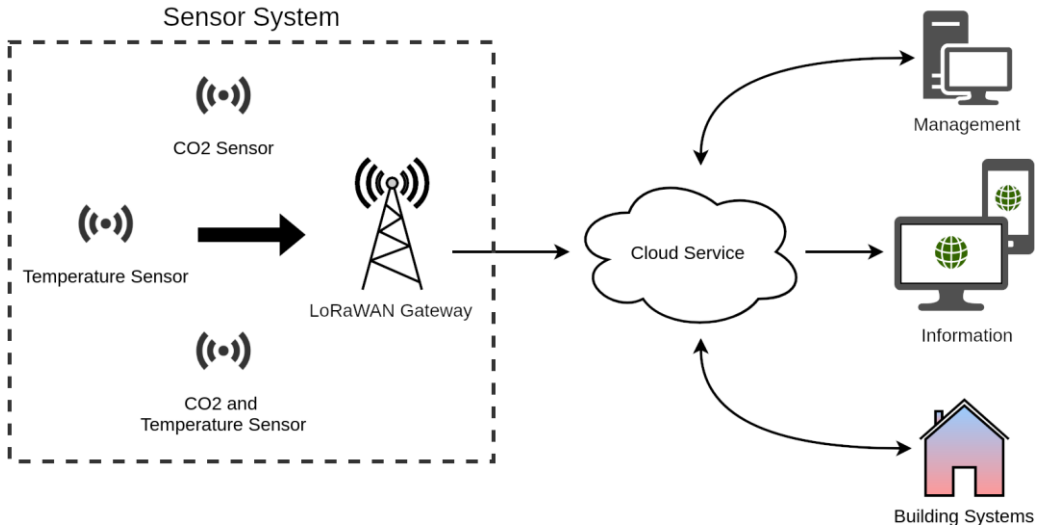
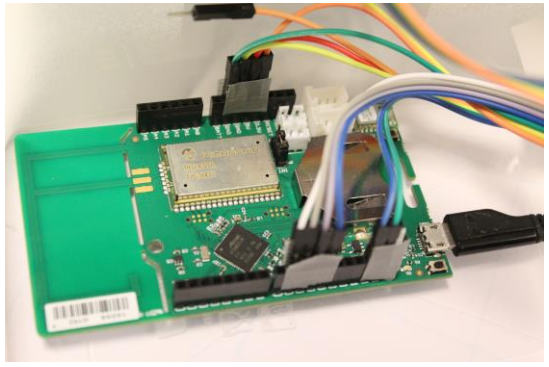
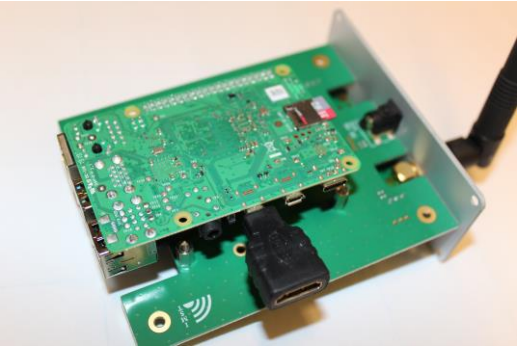
3. Embedded relational database prototype system.

Self made sensor device to collect environmental data

- Devices:
  - BME680 sensor for temperature, relative humidity and atmospheric pressure
  - SGP30 sensor for CO2 and TVOC
  - Sodaq Explorer (Arduino) sends data through LoRaWAN gateway
- Software
  - Arduino application use sensors and send data
  - Linux gateway store cached data to SQLite database







P. Rantanen and M. Saari, "Towards the utilization of cost-effective off-the-shelf devices for achieving energy savings in existing buildings", Proceedings of 2020 IEEE 10th International Conference on Intelligent Systems (IS20), Varna, Bulgaria, 26-28 June 2020.

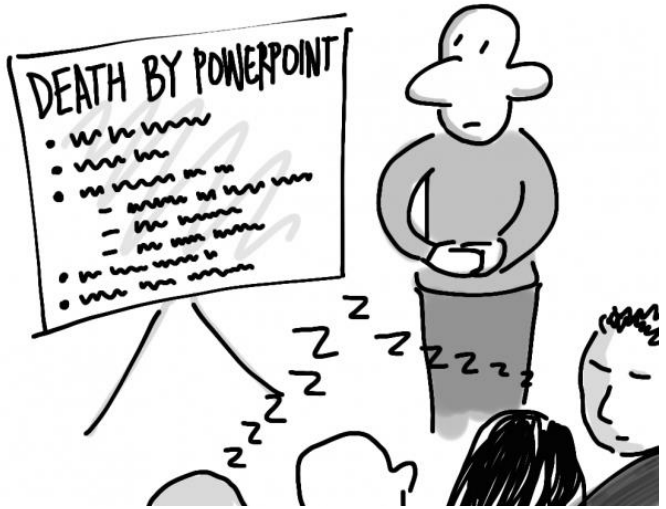
Summary and the next step(s)

Findings:

- No clearly “best choice”
- The study introduced three different use cases of storing and handling IoT data
- In general – All of these scenarios the data storing could be done in timeseries style. (it already use time stamps)

The Time series database with the general-purpose visualization tool are suitable toolset for this kind of context.

- What next?
  - Experiments continue and more IoT data will be collected.



More information

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