Telemonitoring and telesupervising of high risk activities

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Background

- **Wearable technology** can be applied to **emergency operators** performing **high risk activities.**
- Augmentation of currently available **protective garments** through the integration of miniaturized **ICT** building blocks: **sensors**, **actuators**, **power generation & storage**, **data transmission**.

Which emergencies and operators?

- **Fires**, **flooding**, **earthquakes….**
- **Remote monitoring** of the operator **activity** and **health state**
- For **fire-fighter** and **civil protection** operators
- But also **risky workers**, **sportsmen….**

System concept

Set of **sensing garments** integrating **wearable sensors** for **physiological** and **environmental** parameters detection

- **T-shirt** in contact with the skin
- Protective **coat**
- **Boots**

On-body measurements

The T-shirt includes those sensors whose measurement needs a close contact with the human skin

- **Heart rate** -> **textile electrodes**
- **Breathing rate** -> textile integrated **piezoresistive** or **piezoelectric** sensors
- **Skin temperature**
- **Dehydration** -> textile based sodium **electrochemical** sensors

Off-body measurements

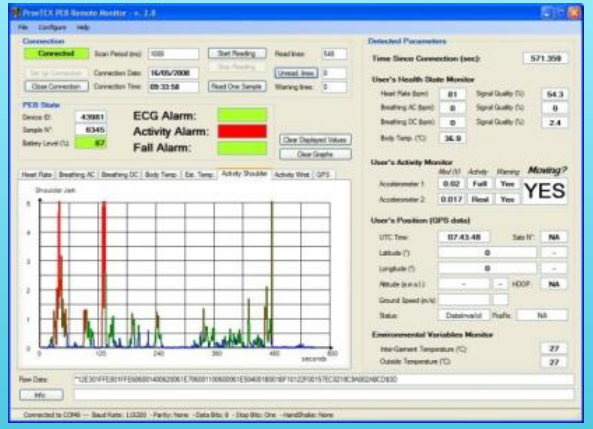
On coat integration of the sensors that do not need close contact with the human body

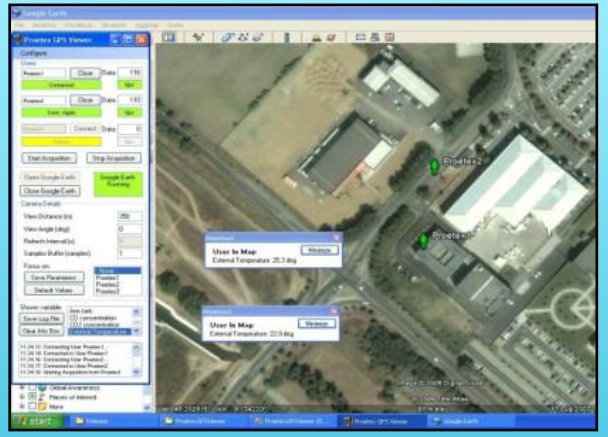
- **Posture and activity** -> three-axial **accelerometers**
- **Absolute operator position** -> GPS
- **Toxic gas** concentration -> **CO** sensors
- **External temperature**
- **Heat flux** through the protective layer

Boot can be used to integrate other useful sensors and systems

- **Posture and activity** -> in-sole **pressure** sensors
- **Toxic gas** concentration -> **CO2** sensors

System architecture (I)



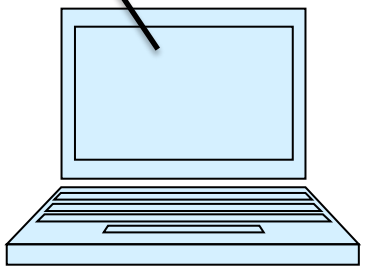


Wired or wireless Network

Trasmissione wireless a lungo raggio (WiFi)

ZigBee

1.5 Km

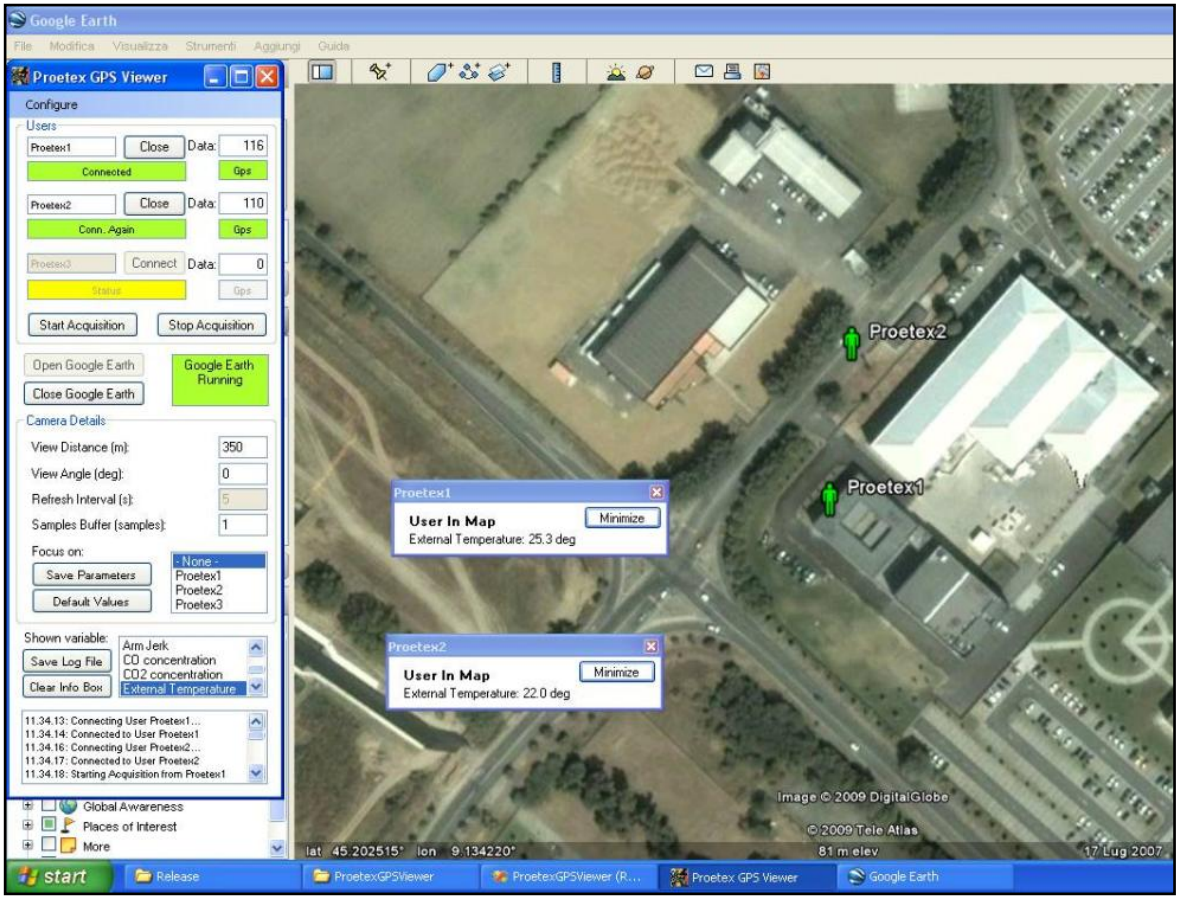


Software and user interface

Real time representation of **geo-referenced** data

Multi-operator representation on **Google-earth**

Each operator is associated with his **parameters** and **risk index** (threshold based)



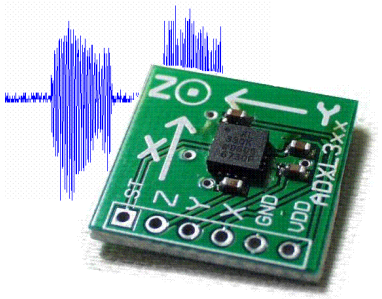
Data interpretation

Direct alarm generation based on the absolute sensor value:

1. **toxic gas concentration**
2. **heat flux across the coat**
3. **environmental temperature**

Automatic real time elaboration of accelerometer data to identify dangerous situations:

1. **long term operator immobility**
2. **operator fall to the groun**



Combination of activity and physiological data

1. **abnormal heart rate on the basis of the current physical activity**
2. **refinement of activity classification from the combination of heart rate and accelerometer data**

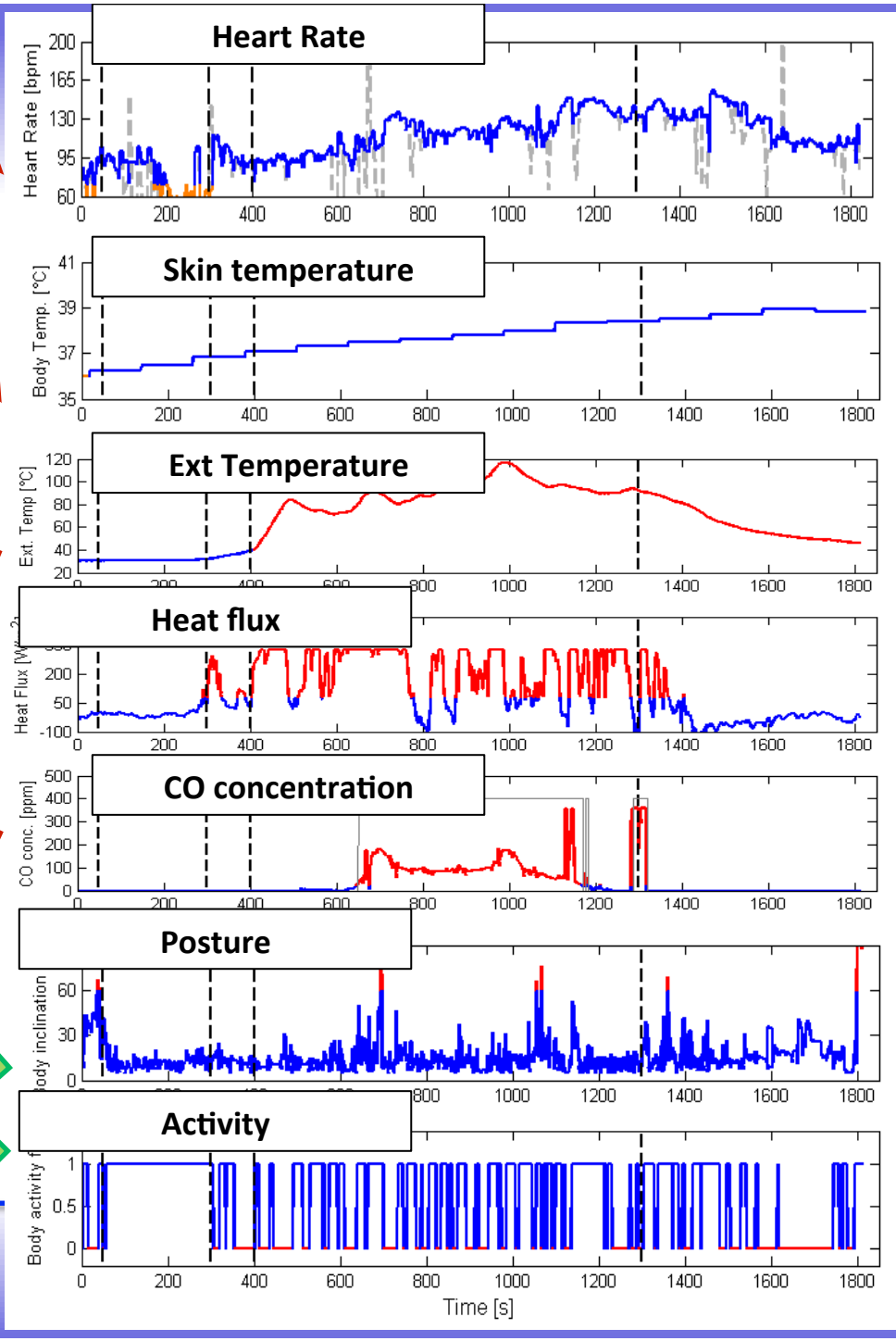
Example of real word acquisition

Test on fire-fighters performed within the **Proetex European project** (FP6-2004-IST-4-026987- www.proetex.org)

Heart rate reaches **165 bpm**; **skin temperature** overpasses **39°C**; **external temperature > 100°C**

CO concentration passes the **100 ppm** threshold (need of gas mask)

Operator in **standing** position and he is continously moving



Knowledge Acceleration and ICT

Conclusions

- Miniaturized ICT technology can be employed for the telemonitoring and telesupervising of operators involved in high risk activities.
  - **Currently tested/validated on fire-fighters and civil protection operators**

- Very important achievements obtained on sensor development for real time operator monitoring
  - **less has been done in terms of high level data interpretation (e.g. health status prevention) and dedicated telecommunication infrastructure**

- Some of the described technologies have reach the required maturity to be employed in real life high-tech products.