

Human and Environmental Sensing for Hazardous Professions

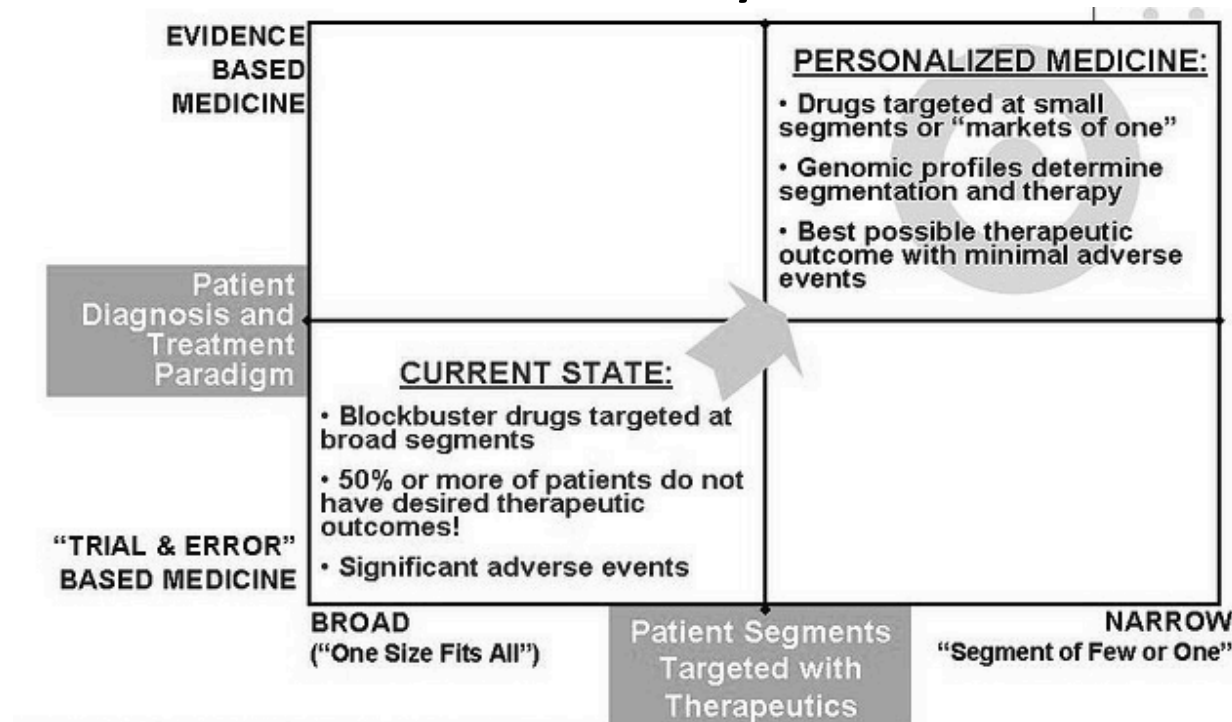
João Paulo Cunha, PhD

jcunha@ieee.org



Personalized Medicine(PM)

- PM is a global tendency in the healthcare and wellness area these days



Personalized Healthcare

- “We view personalized healthcare as a broader platform that includes genetics and genomics but also includes any other biologic information that helps predict risk for disease or how a patient will respond to treatments. “

Cleveland Clinic official presentation

Wearable electronics

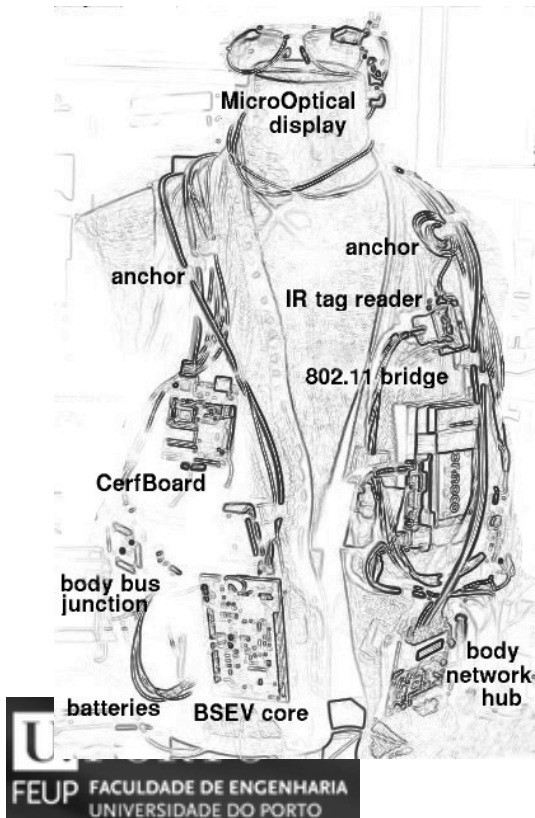


Circa 1949



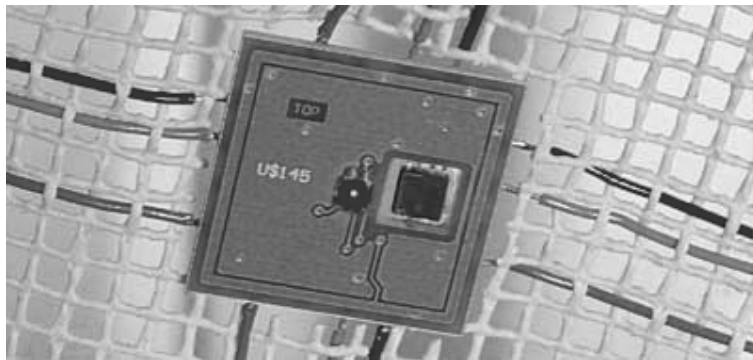
Wearable electronics

- Project MIThril – “wearable computing” platform, MIT
- Based on MIThrilBus - 2000
- Heavy and complex. Based on a linux Sharp PDA



Wearable electronics

- Infinition AG, Germany
 - Yarn embedded chips
 - First commercial products, 2006





Monitoring electronics? ... in a store near you...

1. Pocketfinder personal GPS locator
2. Tagg GPS dog tracker
3. Fitbit One and Zip physical activity sensors
4. iPING personal putting coach and app
5. Wahoo Fitness bluetooth heart rate strap
6. Scosche Rhythm heart rate monitor armband
7. Jawbone Up physical activity and sleep sensor
8. Pear Training heart rate monitor and training app
9. Adidas MiCoach bluetooth heart rate monitor
10. Adidas MiCoach Speed Cell activity sensor
11. Nike+ sports sensor
12. Nike+ Fuelband physical activity sensor
13. Withings baby monitor
14. Philips in.Sight wireless baby monitor
15. IZON Wireless Camera -
16. Philips in.Sight wireless camera
17. Lark sleep sensor wristband
18. Lark Life physical activity and sleep sensor
19. iBGStar blood glucose sensor
20. iHealth wireless blood pressure wrist monitor
21. Withings blood pressure monitor
22. Withings wireless scale

jcunha@ieee.org

Wearable electronics are emerging...





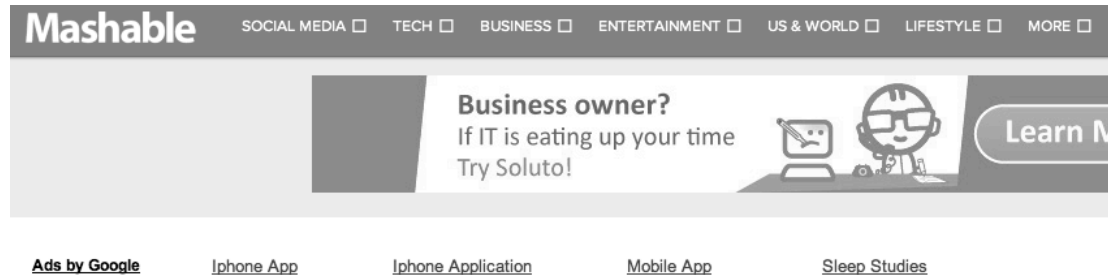
Noah Zerk
@noazark

Yeeeah... I just h
powerful man in
guy. pic.twitter.c

3:12 AM - 21 Jan 13



... +500 apps in the AppStore...



10 iPhone Apps for a Better Night's Sleep

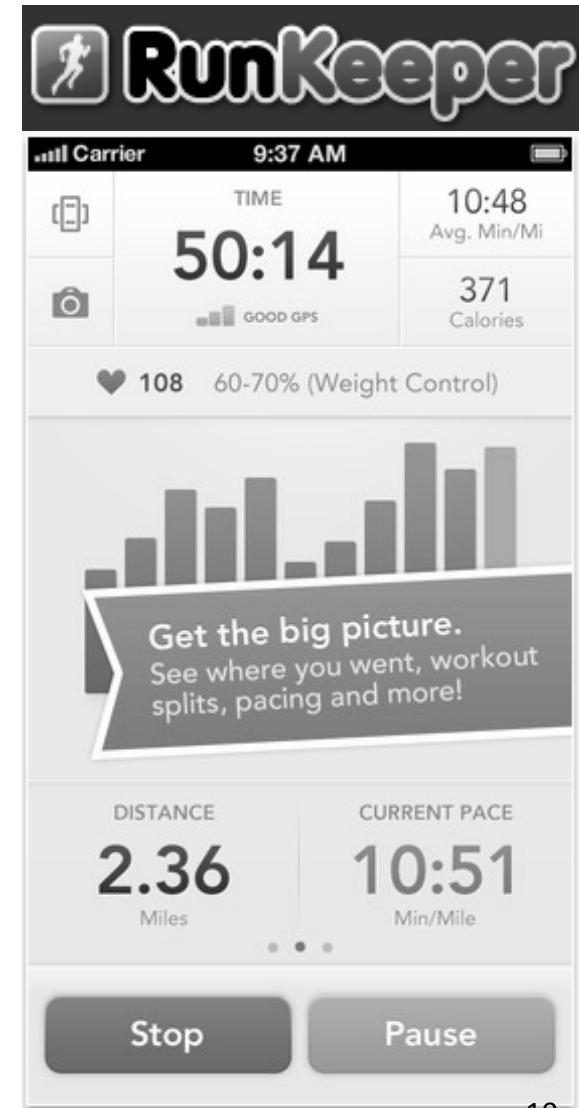
5. Sleep Cycle Alarm Clock



If you're really committed to learning more about your sleep habits, Sleep Cycle Alarm Clock provides you with a tool for analyzing your sleep habits. By literally placing the iPhone next to you while you sleep, the app will monitor your movement and wake you in your lightest sleep phase so you arise feeling refreshed and well-rested.

Cost: \$0.99

jcunha@ieee.org





Quantified Self
self knowledge through numbers

Search

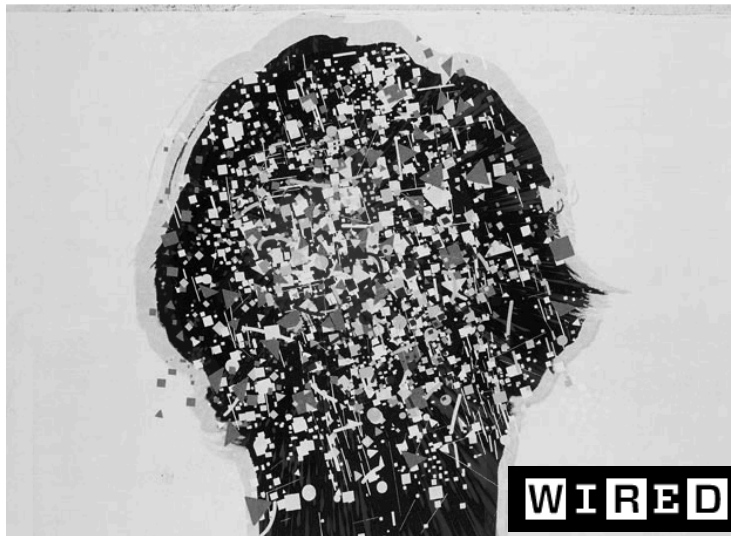
ABOUT VIDEOS FORUMS



Share this:

Twitter 9
 Facebook 1
 Google +1
 Tumblr
 LinkedIn 2
 Email

Posted in [Videos](#) | Tagged [breathing](#), [coherence](#), [emWave](#), [heart math](#), [heartmath](#), [HRV](#), [Inner Balance](#), [qstop](#), [relaxation](#) | [Leave a comment](#)



es you to donate your spit for science! Check out

d/or a runny nose?

per respiratory infections and/or the flu. Donating
ic use, help limit the spread of respiratory

- | | |
|----------------------------------|----------------------------|
| CITY NOT LISTED? | CANADA |
| Start Your Own | Toronto |
| QS Group! | Vancouver |
| USA - WEST | Montreal |
| Bay Area | Ottawa |
| QSXX - SF | London |
| Silicon Valley | (Ontario) |
| San Diego | EUROPE |
| Seattle | Amsterdam |
| Los Angeles | London |
| North Bay | Paris |
| Portland | Manchester |
| Honolulu | Leeds |
| Berkeley | Brussels |
| Santa Barbara | Edinburgh |
| Davis/Sacramento | Valencia |
| Boulder/Denver | Sofia |
| San Francisco | Porto |
| Salt Lake City | Munich |
| Phoenix/ | Berlin |

<http://quantifiedself.com>

- ... BUT, most of these devices and apps have little or none scientific validation...
- ...too many are still immature and FAIL (users got their money back or not...☹)

So... where are we?... really ?!

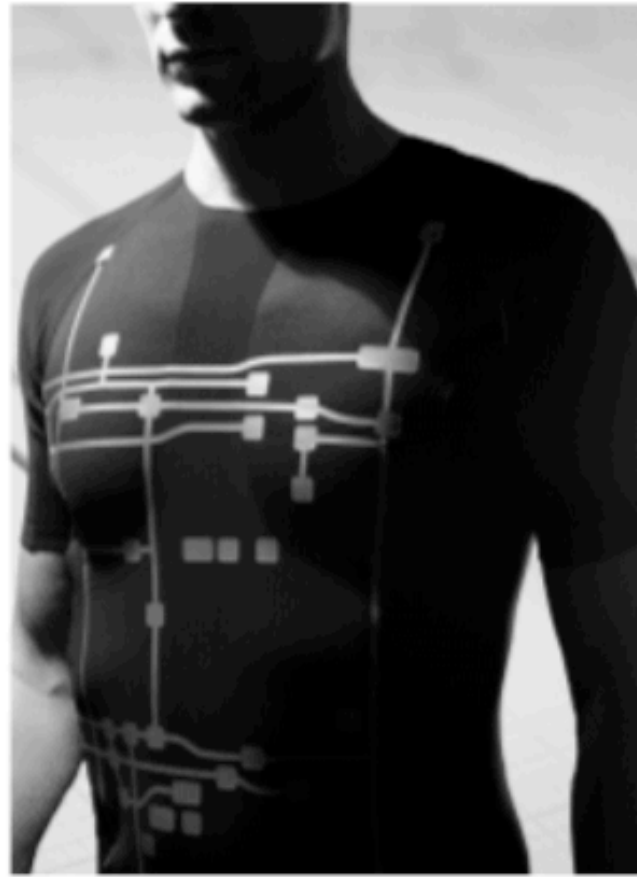
- We are already doing QSelf in citizen groups....
 - patients and elderly
 - high-performance athletes
 - high-risk professionals
- As there is a “medical” intention, we need clinical quality !

Our approach – wearable clinical quality technology

VitalJacket®



a)



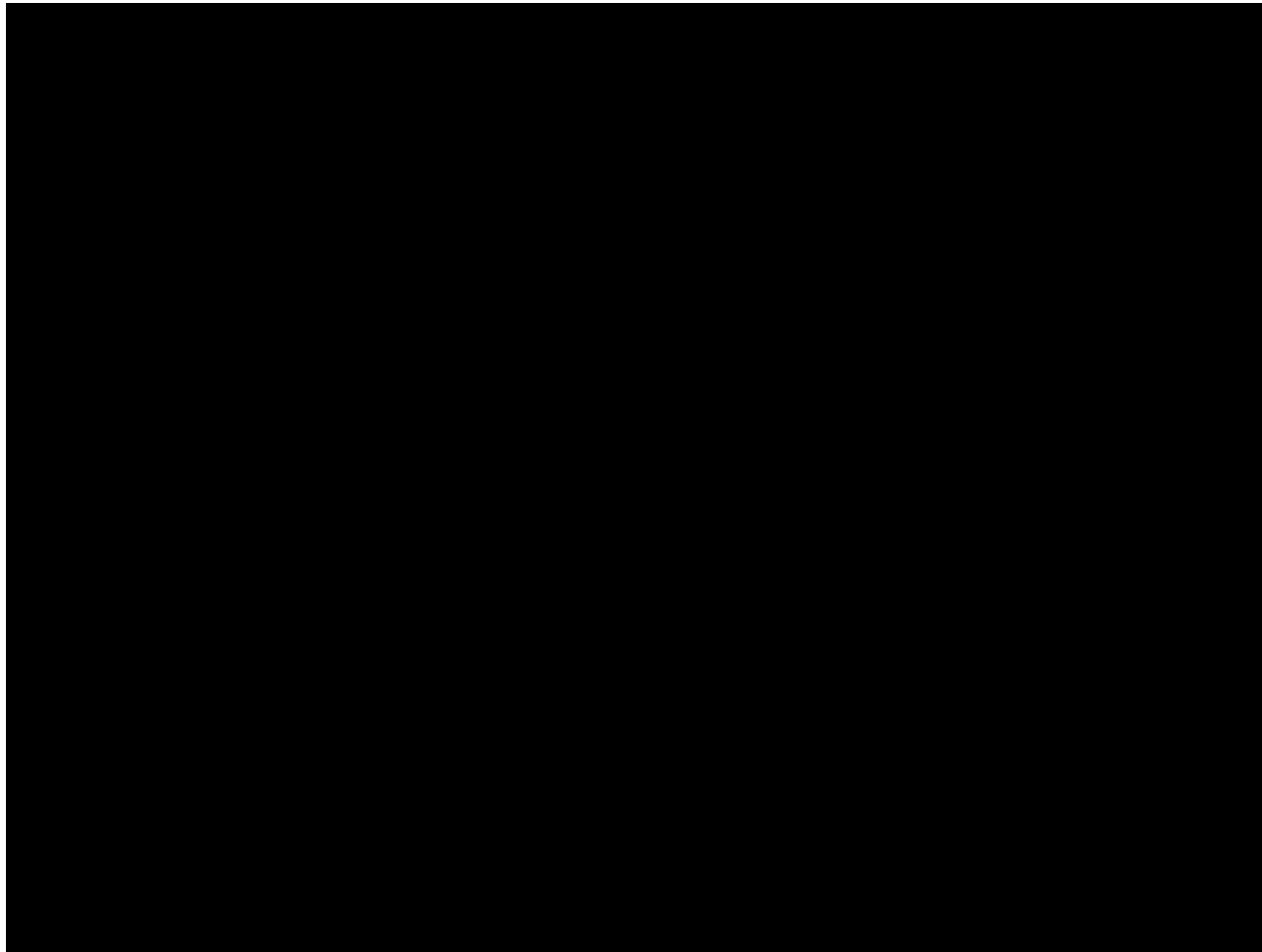
b)

universidade de aveiro



jcunha@ieee.org

QSelf Sports



QSelf Sports



QSelf Cardiology

- Adult
- Child
- Baby



Qself for First Responders

- First Response professionals experience high levels of on-duty stress and fatigue. Stressful events are related to coronary diseases[1]
- Cardiovascular on-duty deaths % in FR is higher and earlier than average (office) population [2]



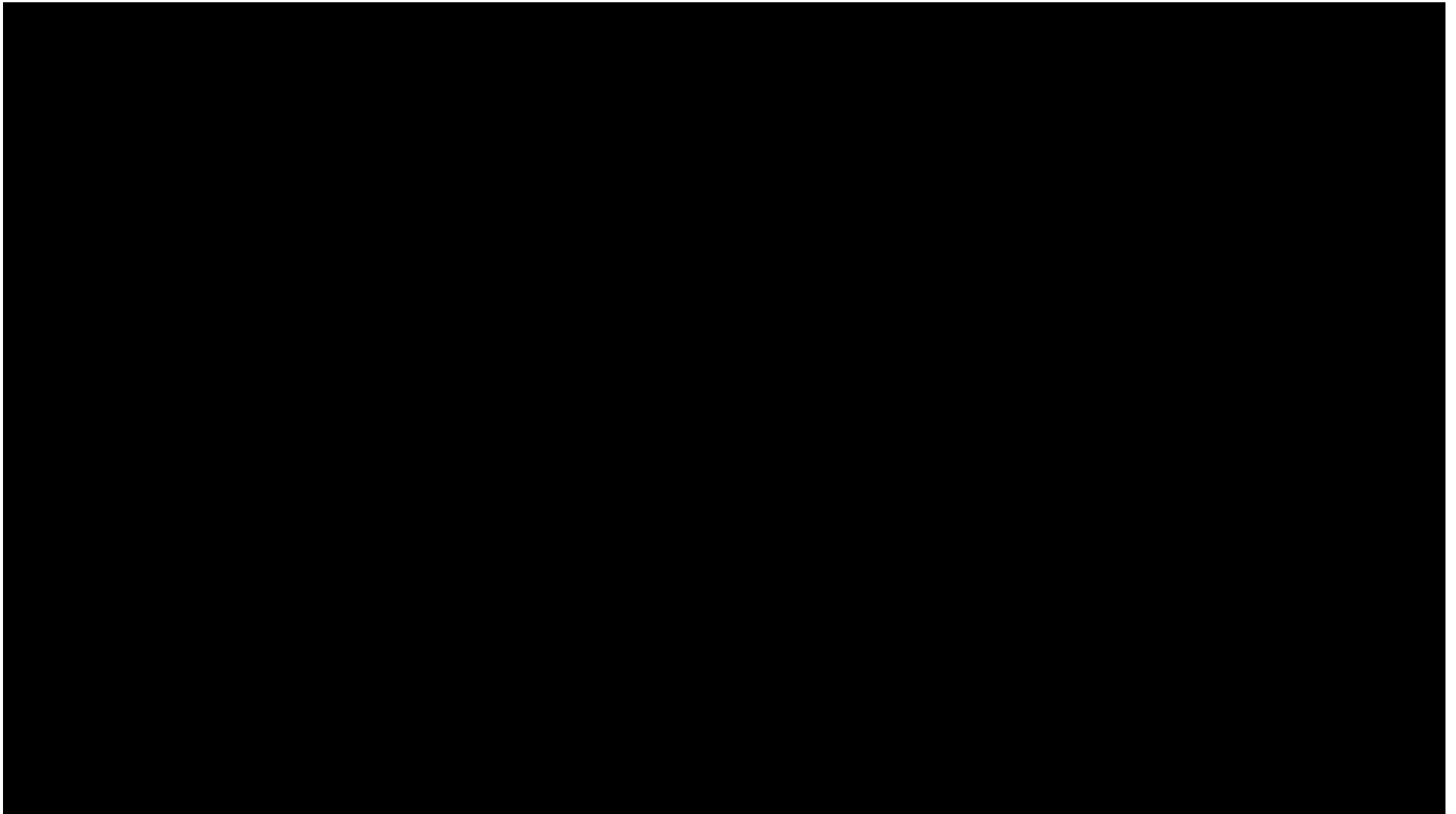
[1] T. Chandola, et al, "Work stress and coronary heart disease: what are the mechanisms?", *European Heart Journal*, 2008, 29: 640-8

[2] S. N. Kales, et al, "Emergency duties and deaths from heart disease among firefighters in the United States", *New England Journal of Medicine*, 2007, 357: 1207-15

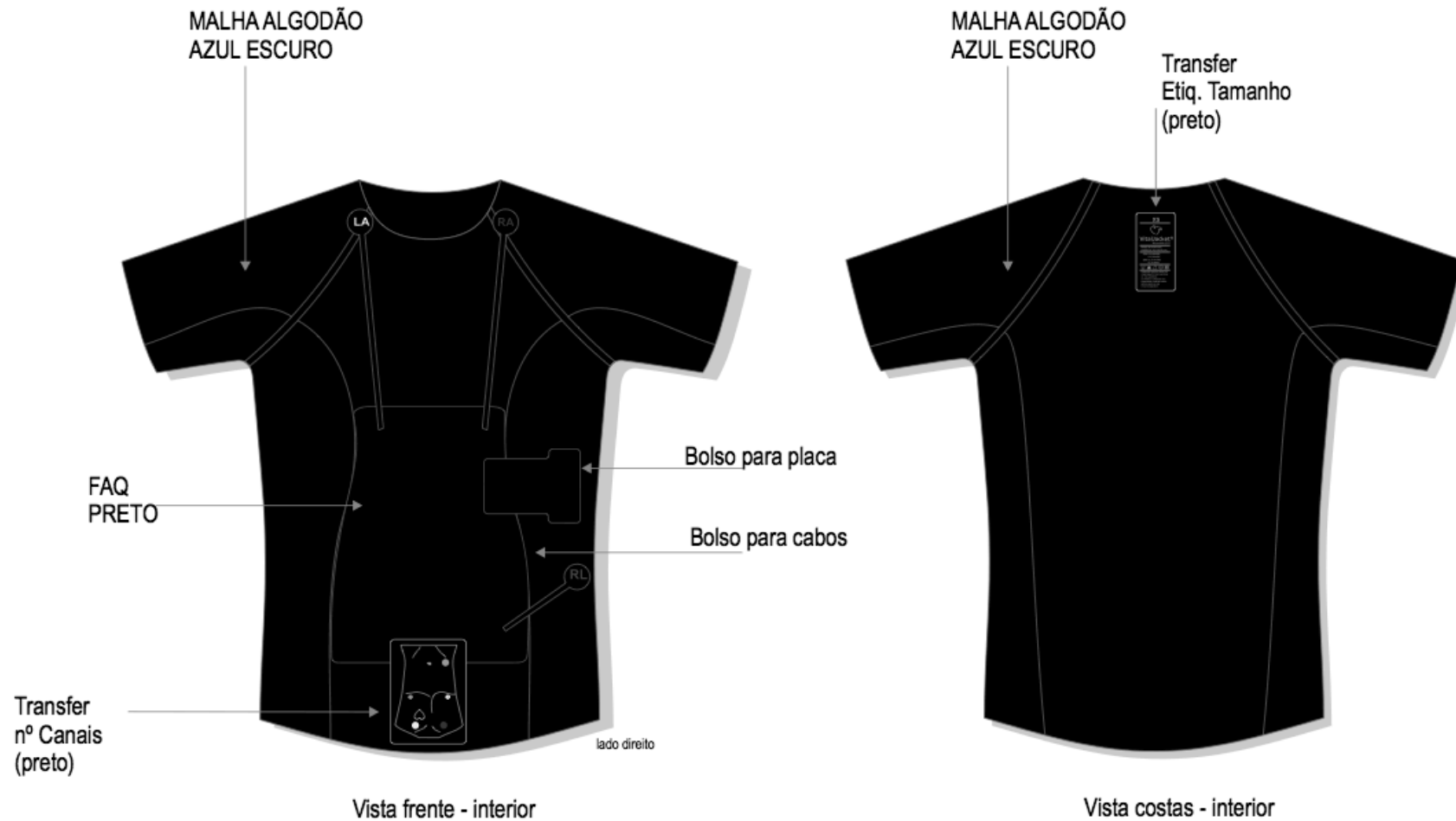
VitalResponder Project



VR project: a 1 min tour... 😊



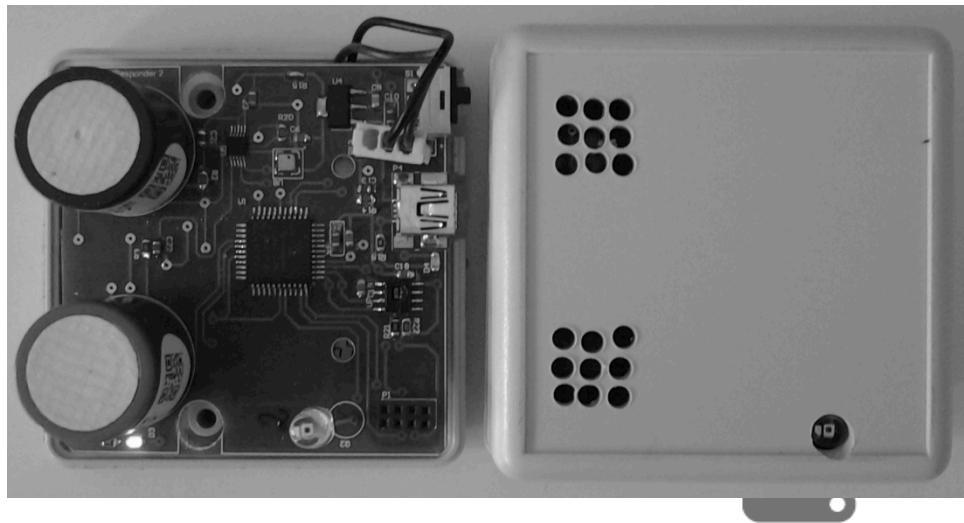
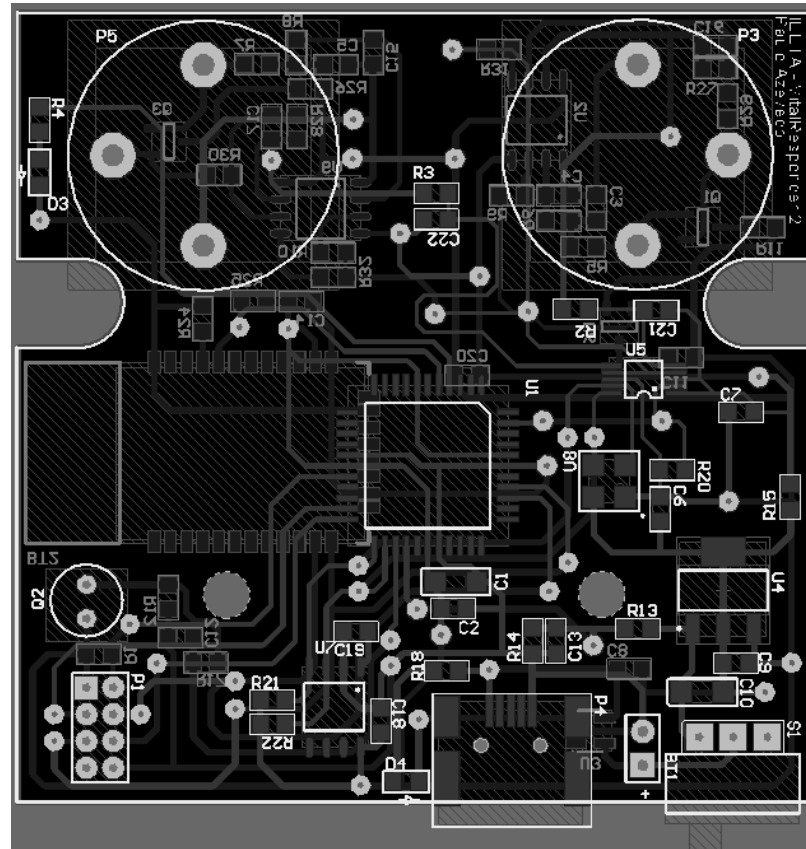
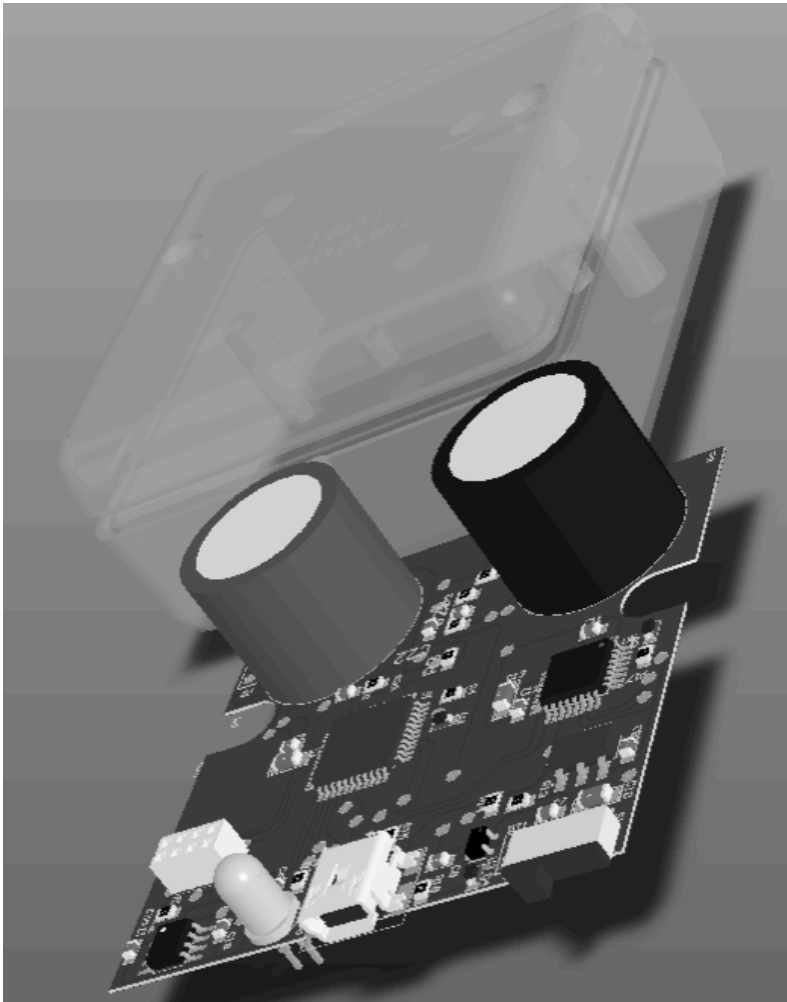
VR WearTech: New textile design



VR WearTech: New Generation of VJ

- According to the national + EU regulation! And:
 - less than 2% of elastin
 - 3 axis accelerometer 40Hz
 - Activity quantification
 - ECG/HR 500Hz
 - Body temp
 - GPS + Ambient Sensors



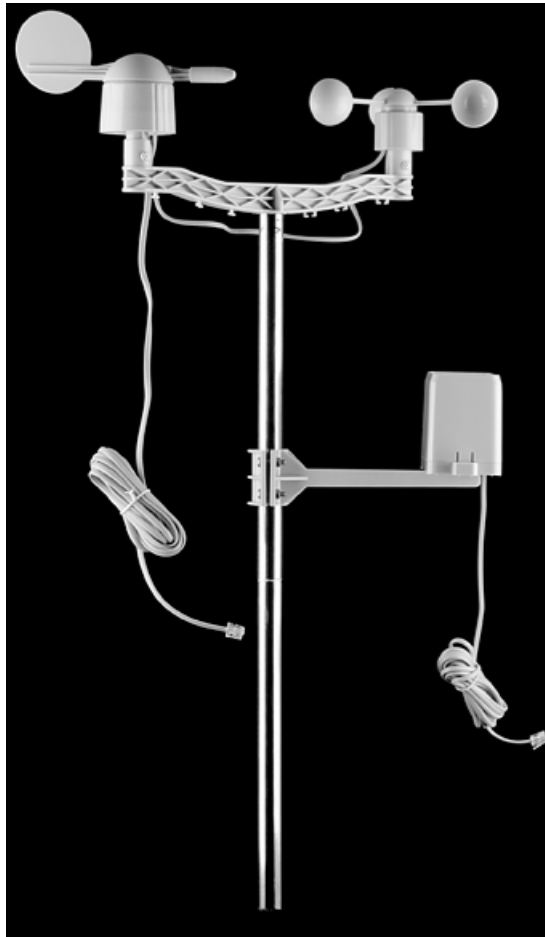


Wearable Tech: Helmet Unit



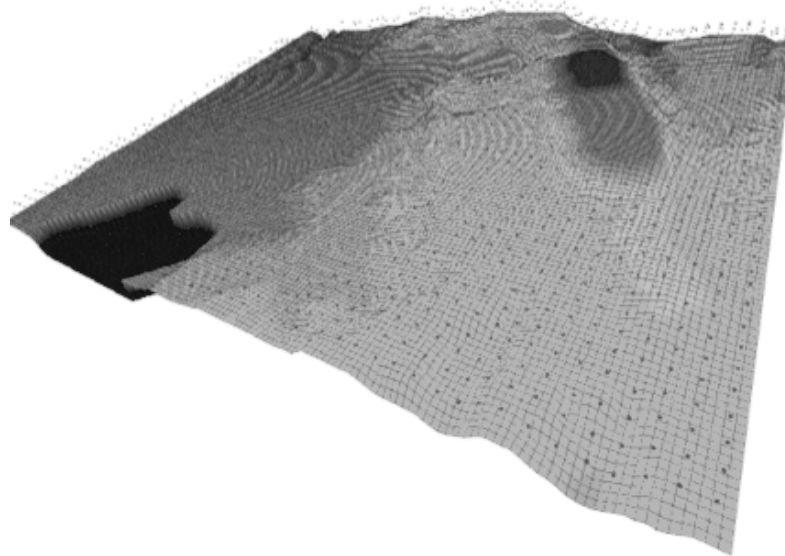
- Temperature
 - - 25 – 50 °C;
- Humidity
 - 10 – 90 %;
- Atmospheric pressure
 - 300 – 1200 mBar;
- Luminosity
- CO (carbon monoxide)
 - 0 – 10 000 ppm;
- N2O (Nitrogen dioxide)
 - 0 – 200 ppm;
- Bluetooth RF communication

Meteo Unit

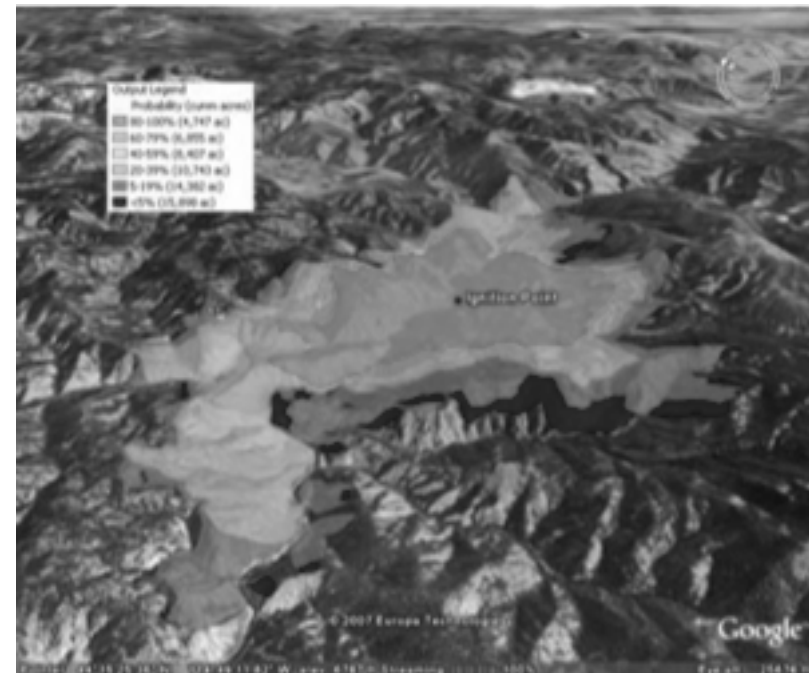


- Wind direction;
- Wind speed;
- Pluviometry;
- Temperature
 - - 25 – 50 °C;
 - Humidity
 - 10 – 90 %;
 - Atmospheric pressure
 - 300 – 1200 mBar;
- Luminosity;
- Bluetooth RF communication

Fire propagation models



Meteo simulation/prediction



Fire propagation models

In cooperation with



U. PORTO

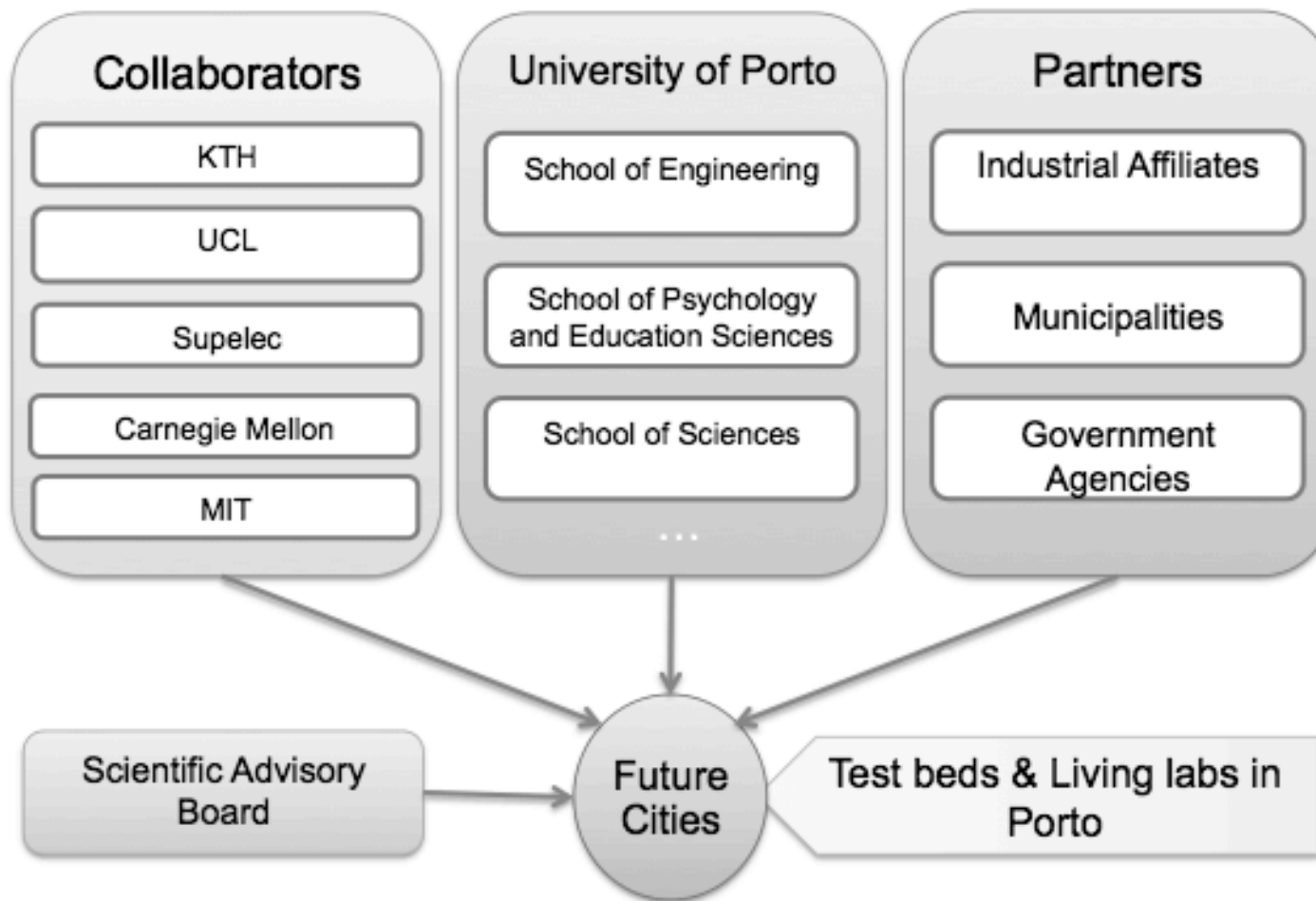
**FUTURE
CITIES
PROJECT
.EU**



FUTURE
CITIES
PROJECT
.EU

Future Cities @ U.Porto

U.PORTO



Build world-class testbeds for urban-scale experiments



futurecities.up.pt

Three Testbeds

VANET SenseMyCity Environmental Sensing

jcunha@ieee.org

29

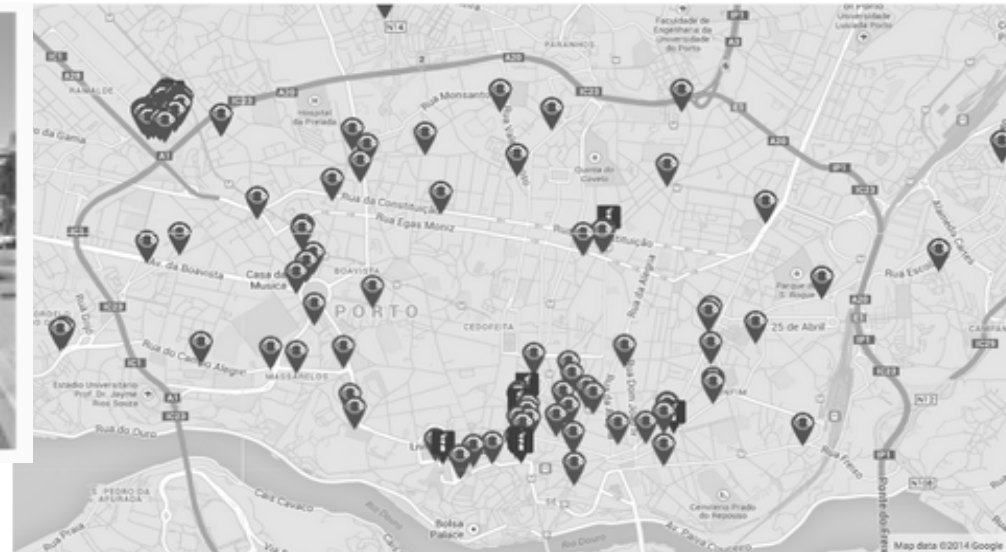


Companies



Institutional Support





VANET is in place

Details

- 402 Buses equipped with NetRiders
- Free Wi-Fi to commuters
- Collection of city sensor's information



VANET - Buses as City Scanners

Frequency map



Buses have city-wide coverage

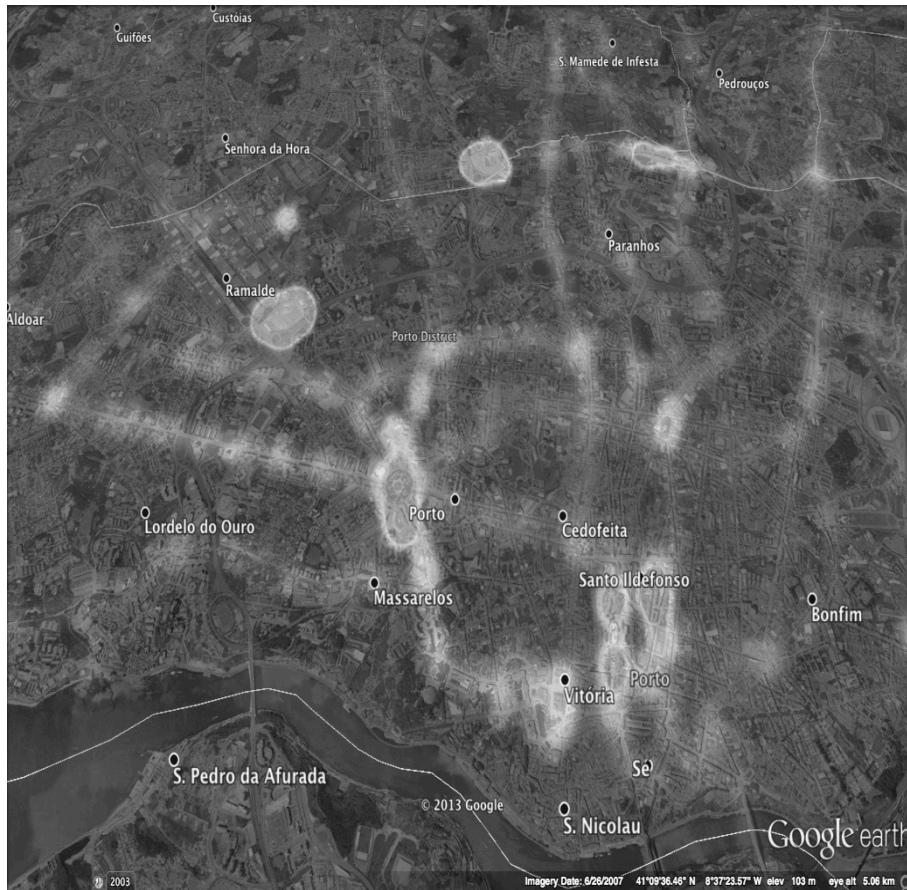
- Scanning the city using sensors
- Detecting and predicting traffic jams
- Characterizing mobility

#vehicles / day

>= 47
40 to 46
34 to 39
27 to 33
21 to 26
14 to 20
8 to 13
1 to 7

VANET - Buses as City Scanners

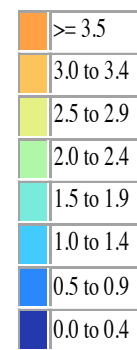
Time map



Buses have city-wide coverage

- Scanning the city using sensors
- Detecting and predicting traffic jams
- Characterizing mobility

#vehicles x hours



(Sample: 108 buses, Wed 27/Nov/2013)

SenseMyCity testbed

SenseMyCity App

is in the hands of the end users.

Algorithms

Mobility pattern

Route similarity

Fuel consumption

Wi-Fi coverage



SenseMyCity: Qself Drivers

The Telegraph

HOME NEWS SPORT FINANCE COMMENT BLOGS CULTURE TRAVEL LIFESTYLE FASHION
UK World Politics Obituaries Education Earth Science Defence Health News Royals
USA US Election 2012 Asia China Central Asia Europe Australasia Middle East Africa

HOME » NEWS » WORLD NEWS » NORTH AMERICA » USA

Teenager steers school bus to safety after driver has heart attack

A quick-thinking seventh grader steered a school bus to safety after the driver was stricken with a heart attack in the state of Washington.



Qself Drivers



Fig. 2. Smart t-shirt used to register ECG and monitor heart rate. Electrodes are only felt during the initial minutes, after which the garment becomes completely inconspicuous. [11], [12]



Fig. 3. Overview of a trip over Freixo Bridge. Hot colors represent higher values of heart rate while light colors represent lower values. [15]

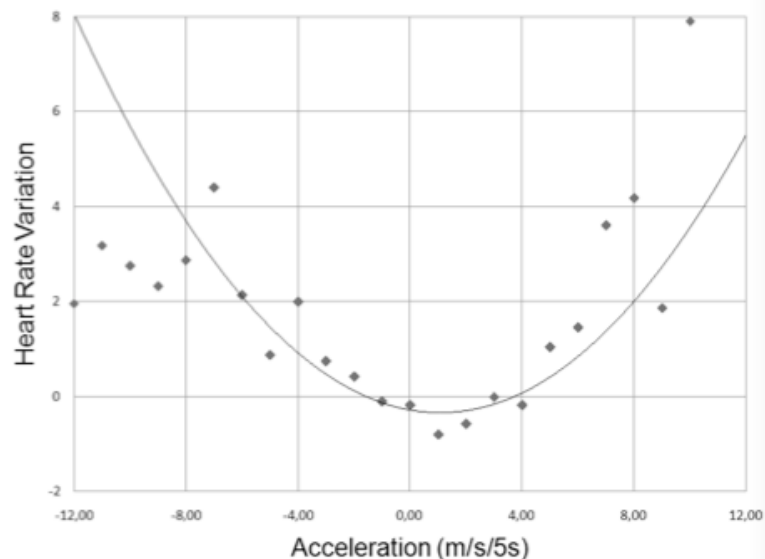


Fig. 5. Average heart rate increase caused by different vehicle accelerations

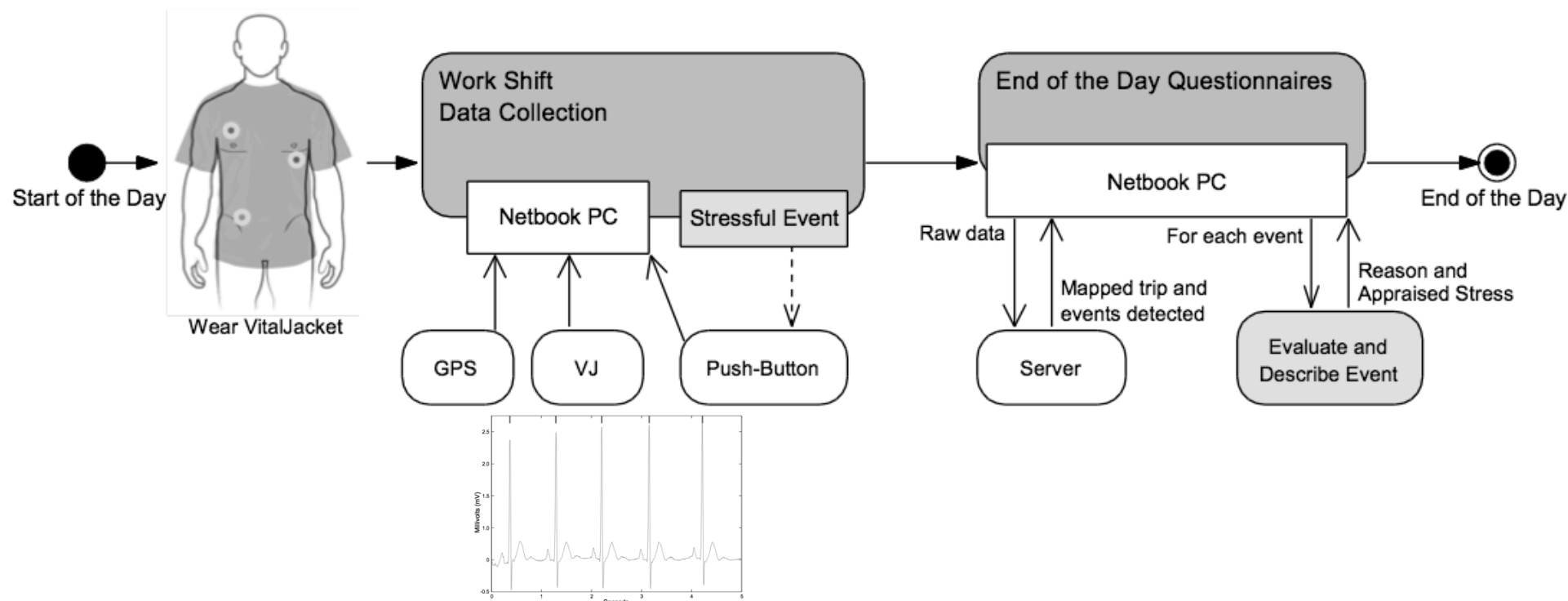
In: Rodrigues et al. , IEEE ITS 2011

jcunha@iee.org

SenseMyCity: QSelf Driver

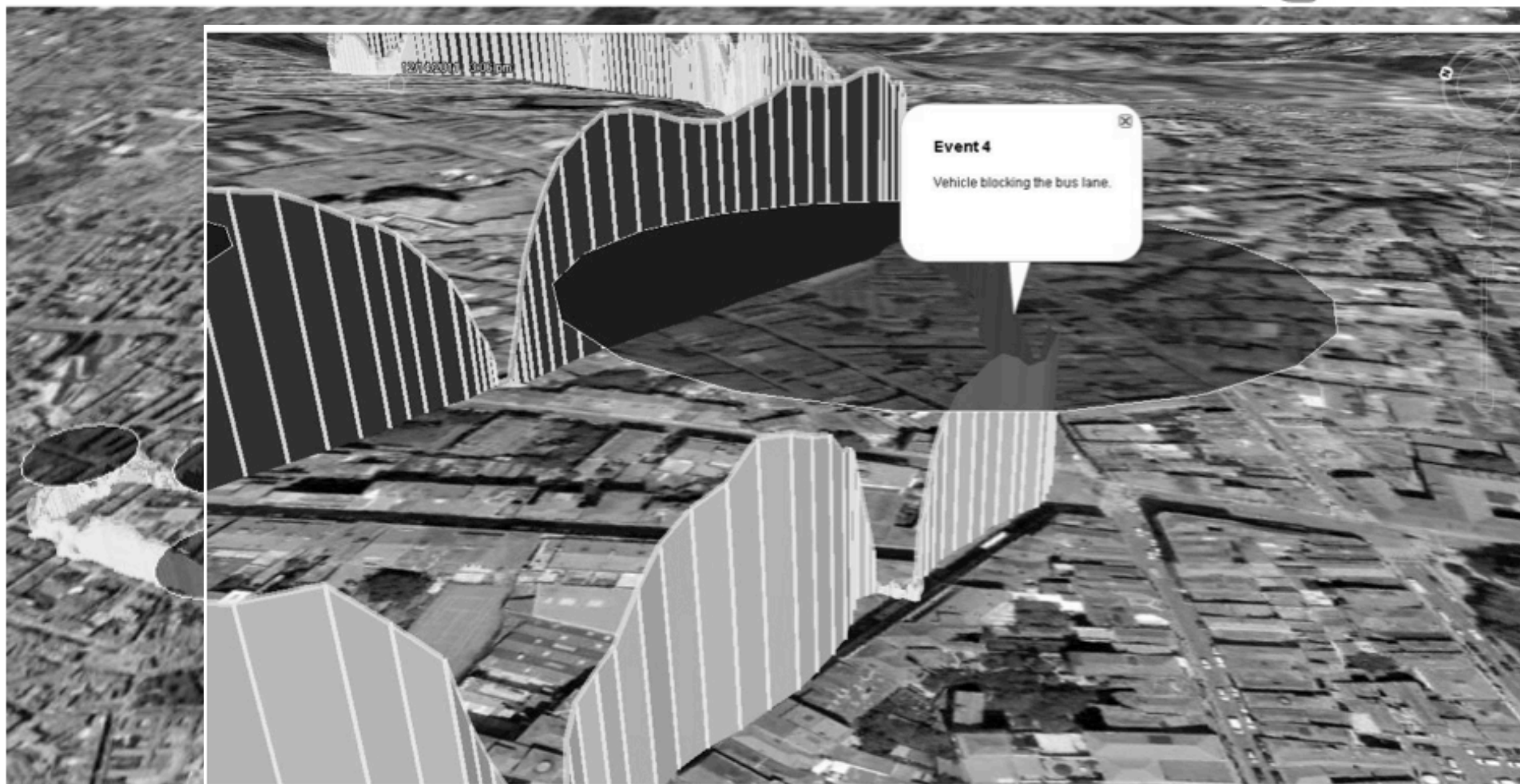


SenseMyCity: Qself BUS Drivers



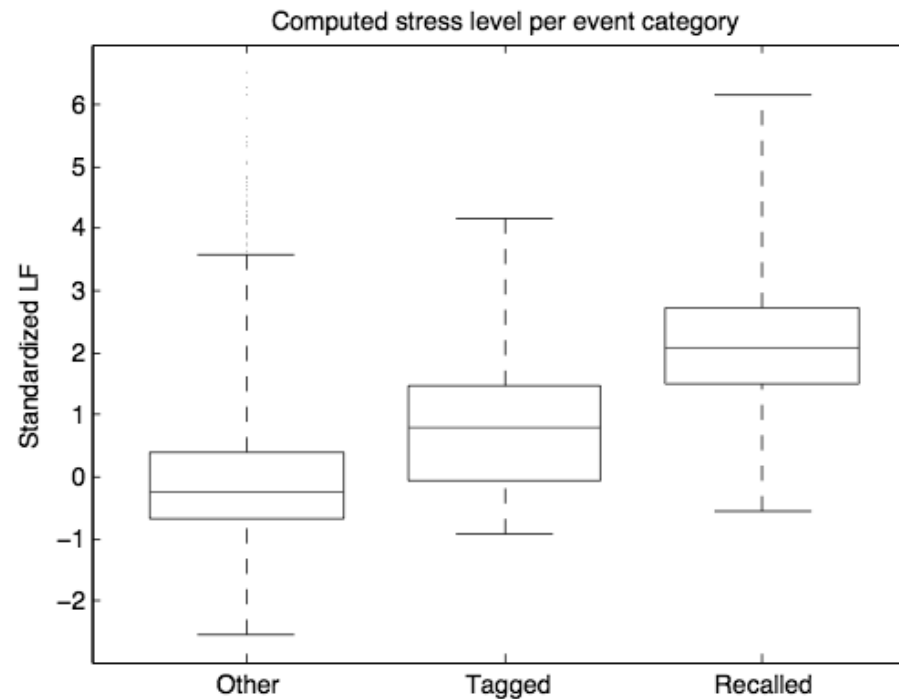
In: Rodrigues et al. , IEEE T-ITS (submitted)

SenseMyCity: QSelf BUS drivers



SenseMyCity: QSelf BUS drivers

- 130 hours of “QSelf” driving collected
- 330 events were reported – 25 Bus drivers
 - 31 events self-tagged; 77 were recalled



In: Rodrigues et al. , IEEE T-ITS (submitted)

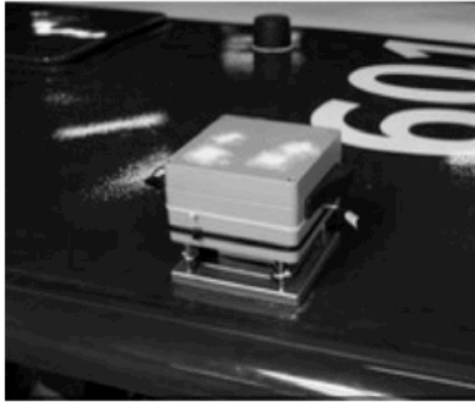
SenseMyCity: Qself BUS drivers



FCities Environmental Sensing

	Mobile Units	Static Units T1	Static Units T2	Counting Units	590 sensors
	50 units	15 units	10 units	60 units	
Temperature & Relative humidity	✓	✓	✓		75
Luminosity	✓	✓	✓		75
Particles PM10	✓	✓	✓		75
Carbon monoxide (CO)	✓	✓	✓		50
Carbon dioxide (CO2)			✓		10
Ozone (O3)	✓	✓	✓		75
Azote dioxide (NO2)	✓	✓	✓		75
Noise		✓	✓		25
Anemometer, pluviometer, wind vane			✓		10
Solar radiation			✓		10
Video Camera				✓	60

FCities Environmental Sensors



Roof of buses

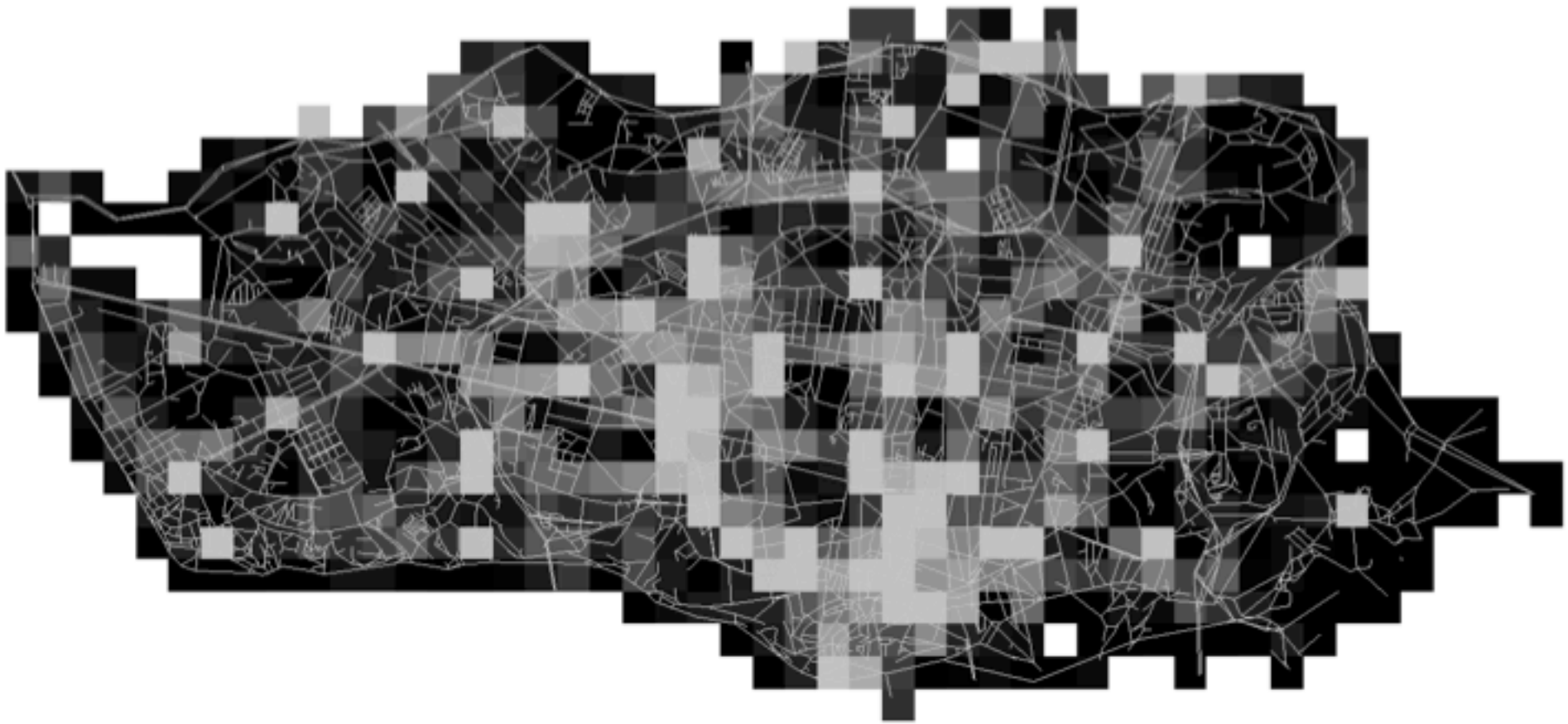


Traffic lights



Balconies

Towards a “sensed and sensible” city



Porto – *Our Living Lab for Future Cities*



Human and Environmental Sensing for Hazardous Professions

More information:

<http://www.vitalresponder.pt>

<http://futurecities.fe.up.pt>

<http://quantifiedself.com>

Contacts: jcunha@ieee.org



New Prototype

