

Application of ZigBee and Bluetooth to Urban Ambient Monitoring and Guidance

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□ Motivation

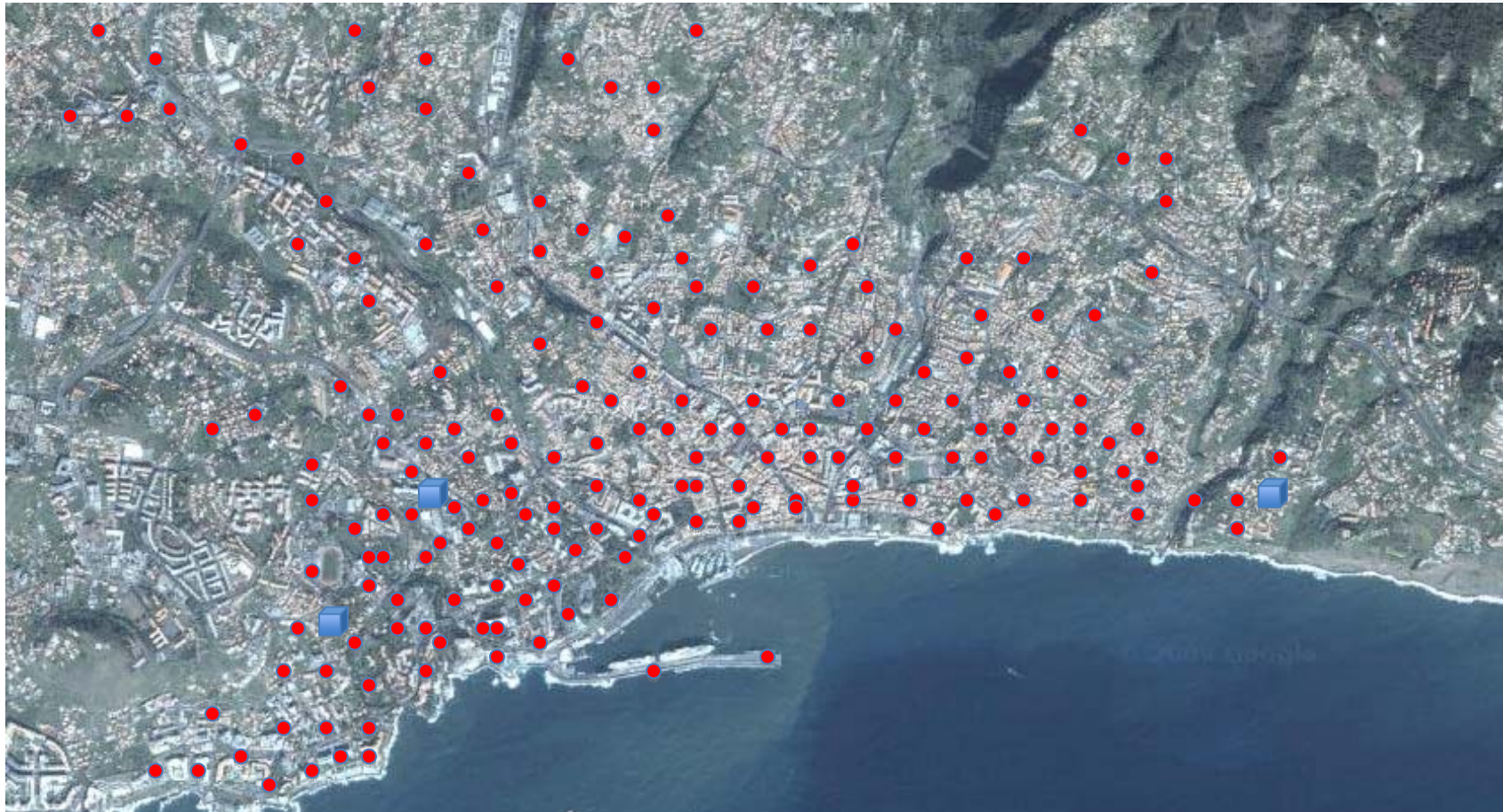
- It's important to monitor environmental parameters, like:
 - Gases pollutants, noise, humidity, light, temperature, barometric pressure and Allergenic Pollens.
- Especially in urban areas.
- Currently in Madeira, monitoring is done through large and expensive devices.



□ Actually



□ Future



□ System definition

- Wireless network of small devices, that offers:
 - Monitoring of ambient parameters;
 - High density of measuring spots;
 - Gather data in real time to a Central computer;
 - Low cost and low power requirements;
 - Promptly access to passersby

Example: Joggers, Tourists.

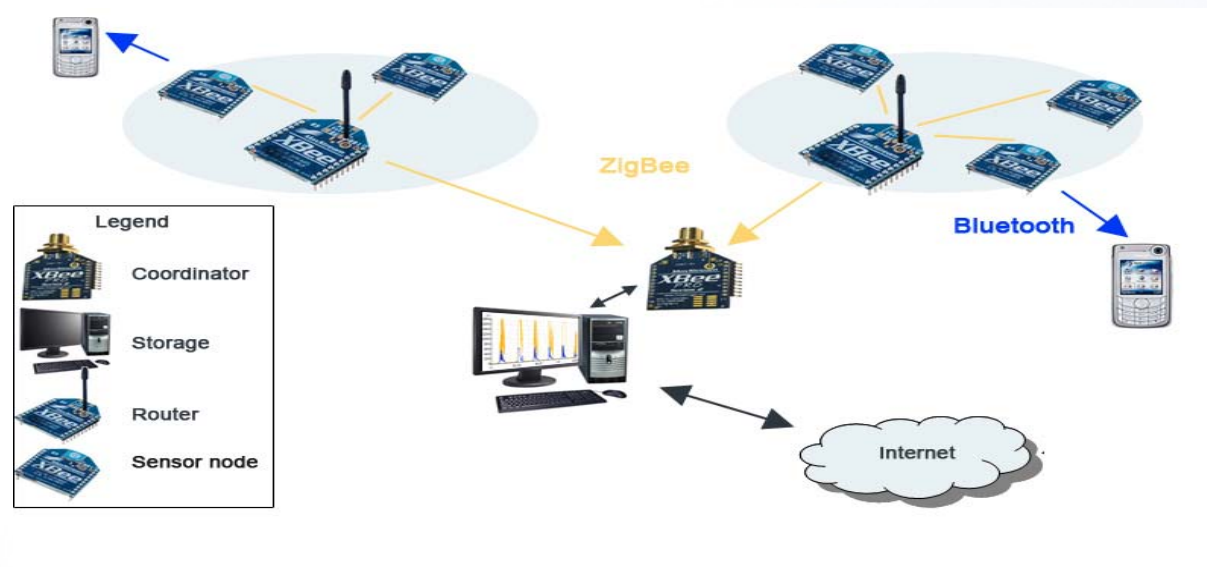
□ Solution

- Integration of two wireless technologies:
 - ZigBee – Wireless technology suitable for sensors networks;
 - Bluetooth – Wireless technology suitable to access closely devices and is present in the majority of cell phones;



Architecture

- ❑ ZigBee using cluster tree topology
- ❑ Each node is equipped with sensors and Bluetooth
- ❑ Central computer with Data Base and HTTP server
- ❑ Java ME application for Cell phones

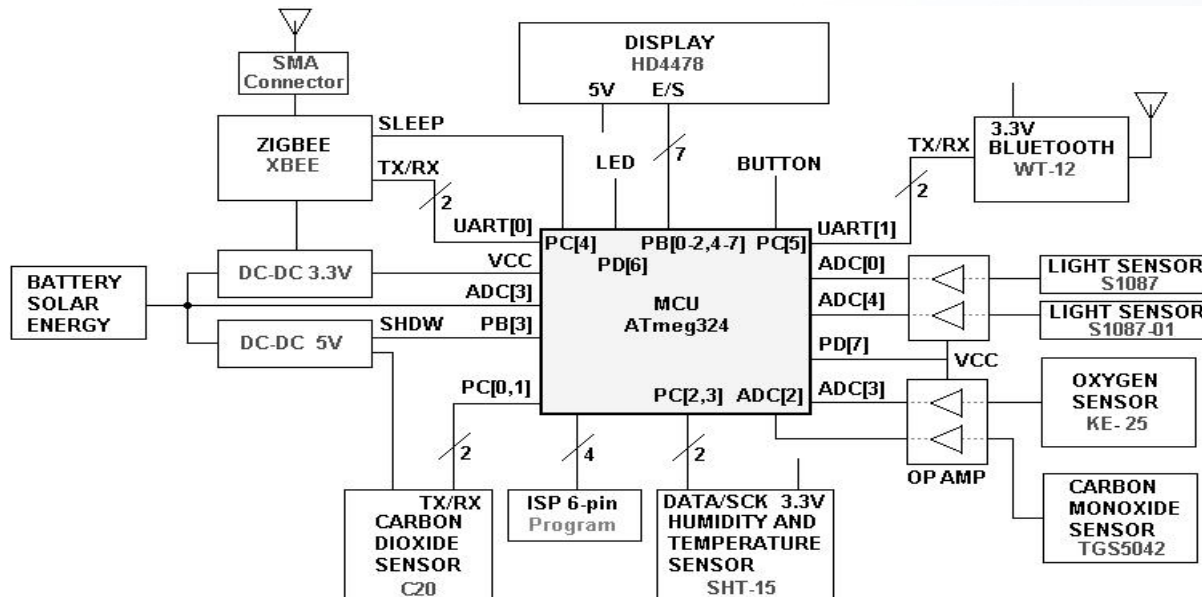


□ Architecture



Module Architecture

- ❑ ATmega324 controls the module – C language
- ❑ Use of step-up DC-DC converters



□ Prototype

□ Radios modules

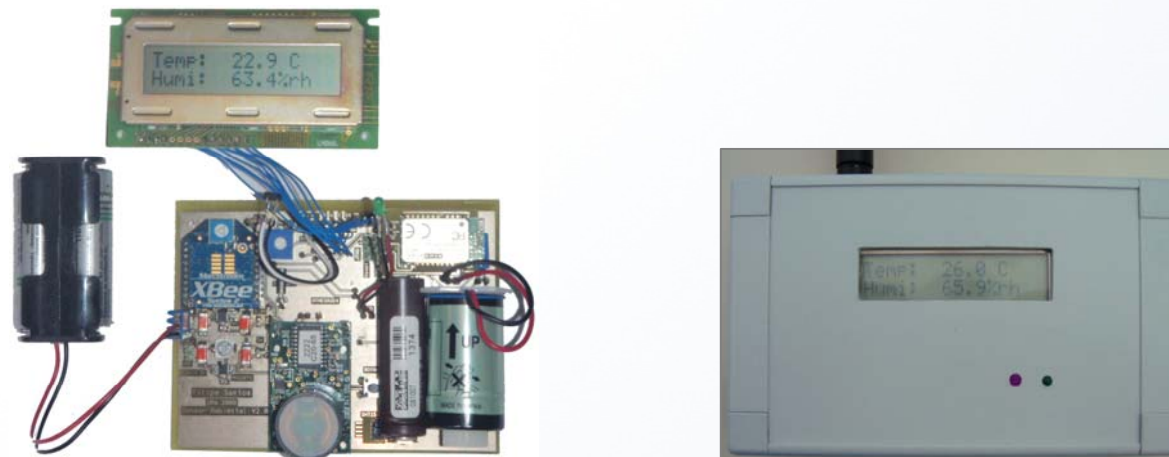
- XBEE from DIGI – ZigBee firmware
- WT-11 from BlueGiga – Class 1

□ Sensors from Sensirion, Figaro, Si Photodiode

□ CO2 sensor – new LED technology from Gas Sensing Solutions

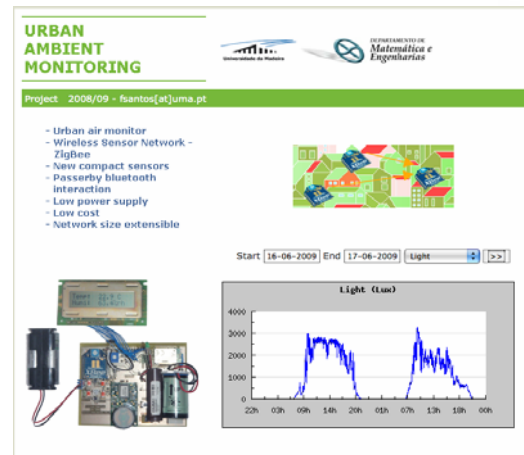
□ LED indicator, display and button

□ Box

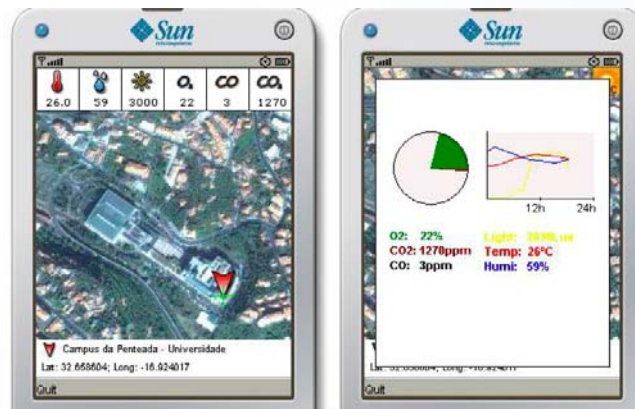


Interfaces

Web page

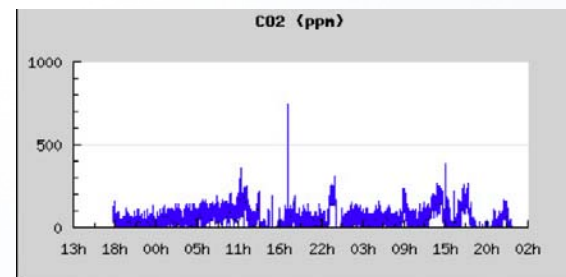
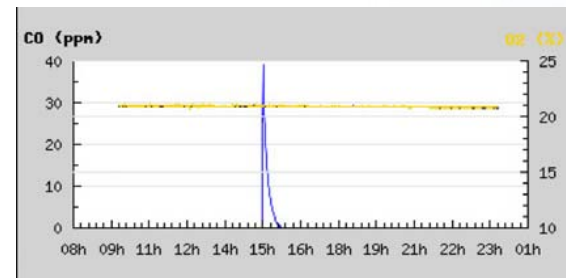
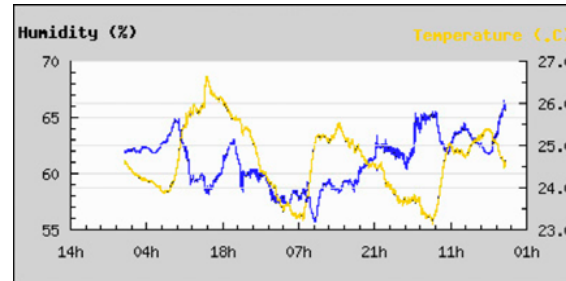


Cell phone application – Java ME



☐ Sensors Results

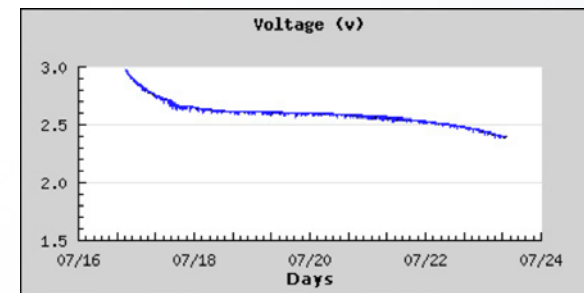
- ☐ Calibrated from factory
- ☐ Good response



Module Specification

Power source usage

- 2xAA battery of 2500mAh
- Measuring and sending information every minute
- 10 Bluetooth requests a day
- Lasts for 7 days



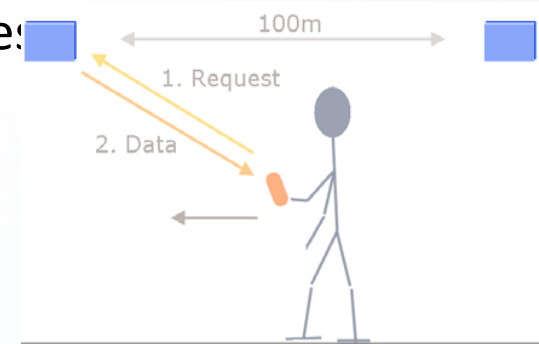
Specifications

Parameter	Values	
	Values	Observation
Current consumption	Avg. < 15mA Max. < 180mA	@ 2.6 V
Humidity Range	10% to 90%	Limited by O2 sensor
Temperature Range	5°C to 40°C	Limited by O2 sensor
Size	144 x 89 x 45mm	Including protection box
Input voltage	1.3 to 3.3V	

Note: Disabling CO2 sensor and Bluetooth => Avg. 1.5mA => 60 days

Bluetooth interaction

- Tests were made walking between two nodes with the cell-phone application running.
- Range from 20 to 100m (depends on cell phone).
- The results showed that at normal walking speed the application changed from one node information to the other after some seconds (< 30s).
- But at higher speed's (like running) some times only one node was discovered (due to cell-phone cache).



□ Conclusion

- ZigBee technology and current sensory technology, allow:
 - high level of integration of features
 - Relative low power consumption
 - Relative small size.
- Adding Bluetooth integration:
 - instant access of important data (change behaviors).
 - diverse possibilities of information to present.
- This work is a middle step to ubiquitous networks.

□ Future work

□ Add solar panel

□ Tests pointed to the use of 1W solar panel

□ Make long run tests in the city

□ “Invisible”



□ Change Bluetooth data for the user from central computer

THANK YOU!!!

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