

## Location Based Services: do they have a role on the health care scenario?

( Current Research on Ubiquitous Computing and AI at DEI)

Carlos Bento  
Francisco Pereira  
Ana Oliveira



# Agenda



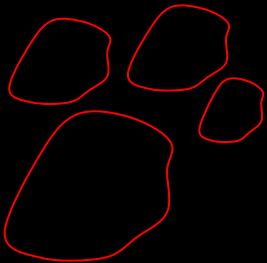
**The Group for UbiComp @ Univ. Coimbra**

**Research**

**Health Care Projects**

**Partnerships**

**Potential for cooperation**





# The Group for UbiComp @ Univ. Coimbra



**Carlos Bento (Senior Researcher)**

**Francisco Pereira (Researcher)**

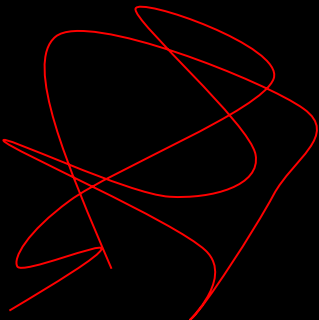
**Ana Oliveira (PhD Student)**

**Nuno Gil (Finishing MSc)**

**Marco Veloso (Finishing MSc)**

**João Peixoto (Finishing MSc)**

**Undergraduate students**





# The Group for UbiComp @ Univ. Coimbra



Ubiquitous  
Computing

Interested on the  
computational  
paradigm and on  
the possibilites  
of this area

Indoor  
Location

GSM, WiFi,  
uParts

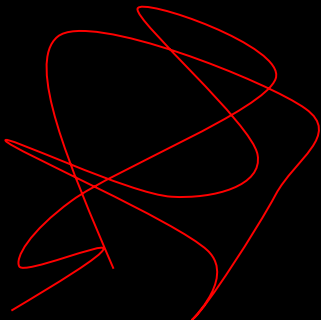
Semantic  
Enrichment  
of Position  
Information

Information  
Retrieval  
supported  
on  
Semantic  
Enrichment  
of Location  
and Object  
Browsing

Applications:  
HealthCare  
(ISF, Lda)

Assistants  
for Cultural  
Spaces (PTI)

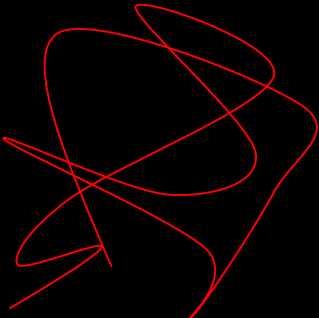
Interfaces  
for  
ambiguous  
keyboards





## Our road map

2. **Indoor location technologies**
  1. **GSM or WiFi signatures**
  2. **Networks of particle computers (sensor networks)**
3. **From position to place (Jeffrey Hightower et al.)**
  1. **A taxonomy for location (Dobson)**
  2. **EJAKI**
  3. **EPORAKI**
  4. **Semantic Enrichment of Place**
  5. **Ontologies for space and objects**
4. **Current applications**
  1. **ISF, Lda**
  2. **Portuguese Telecom (PTI)**

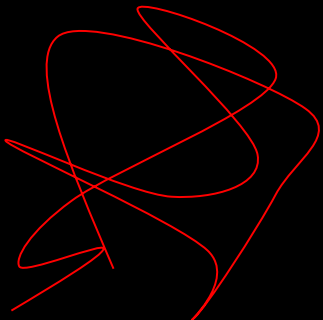




# Research



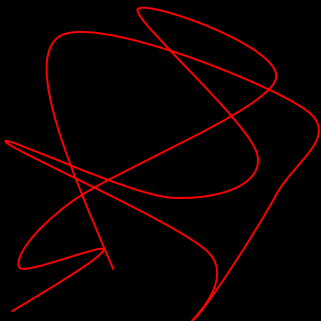
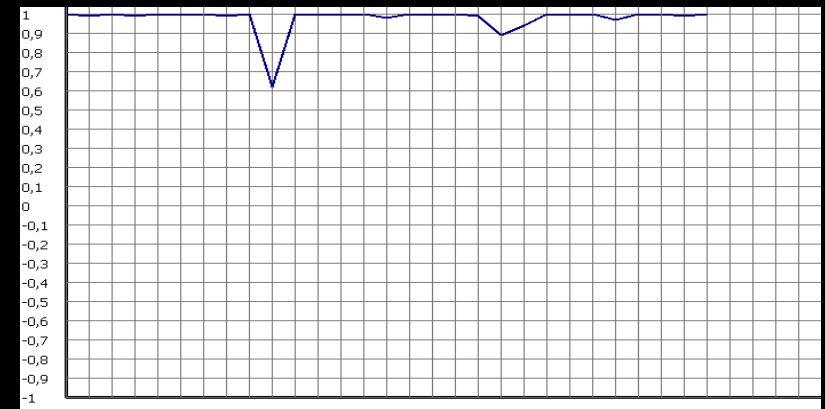
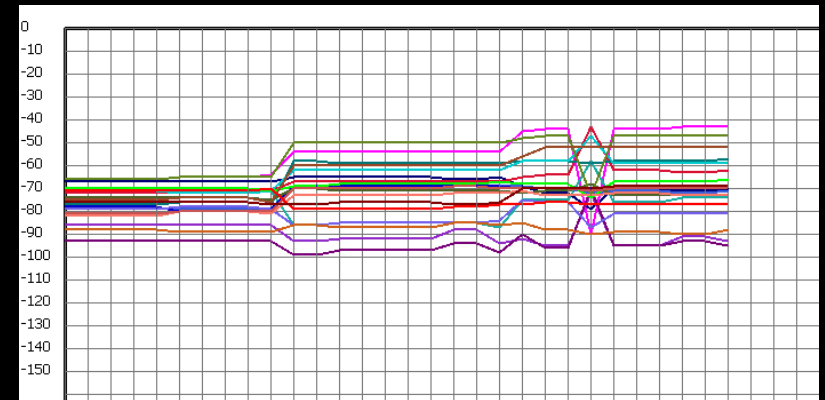
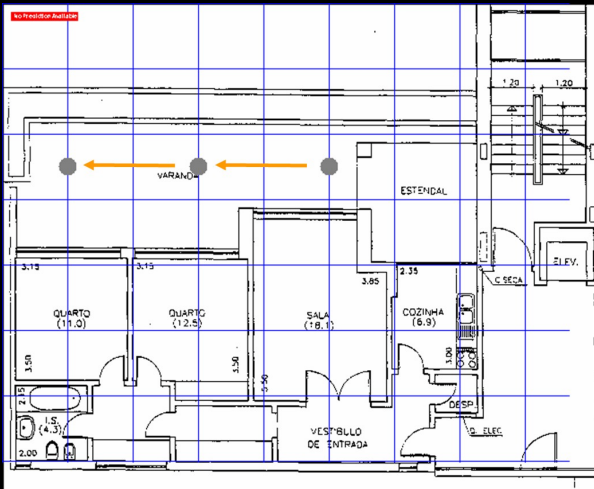
Indoor location using GSM or WiFi signatures



# Research



## Indoor location using GSM or WiFi signatures

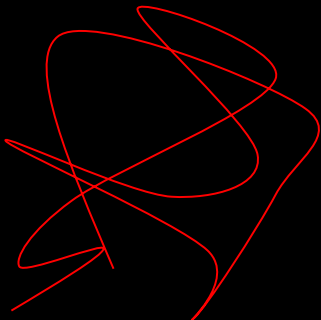
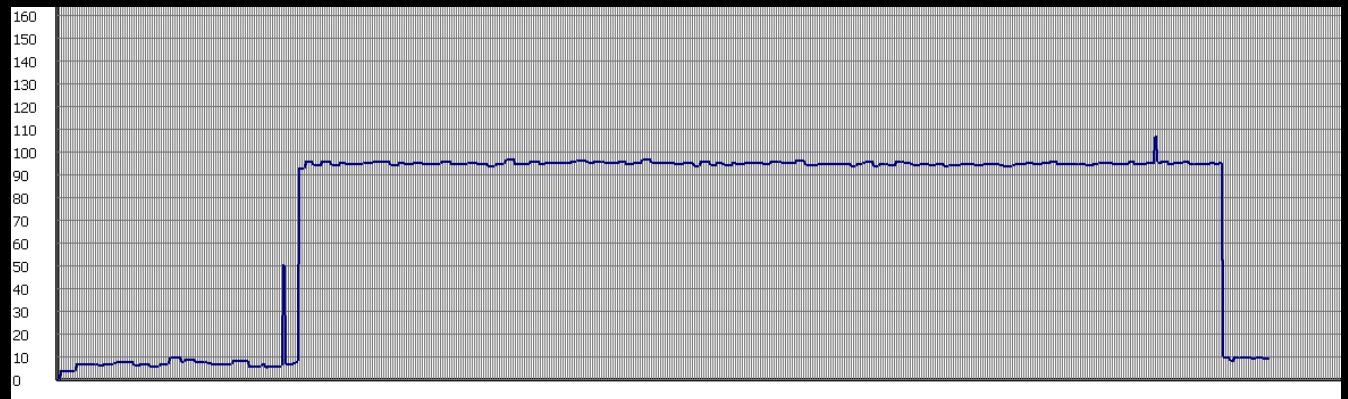
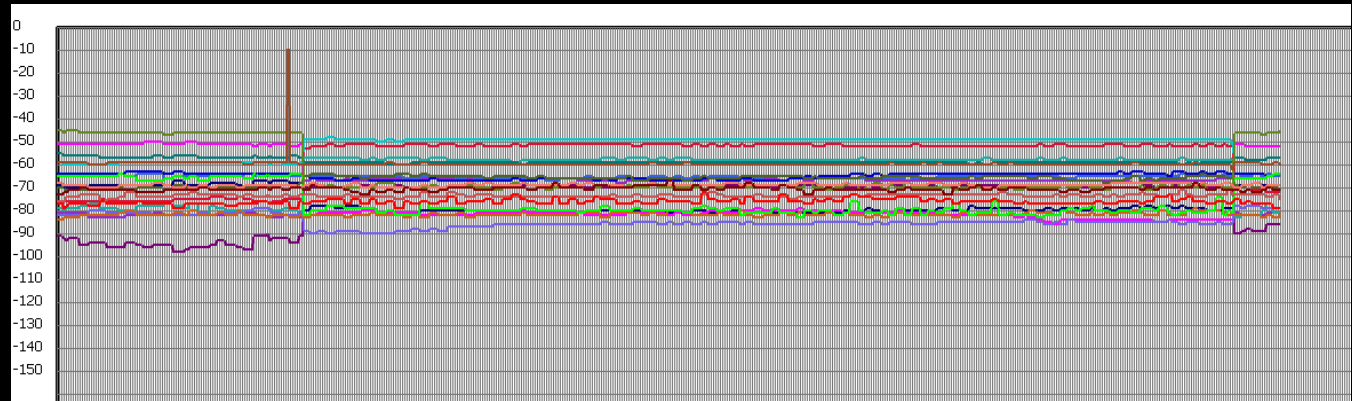




# Research



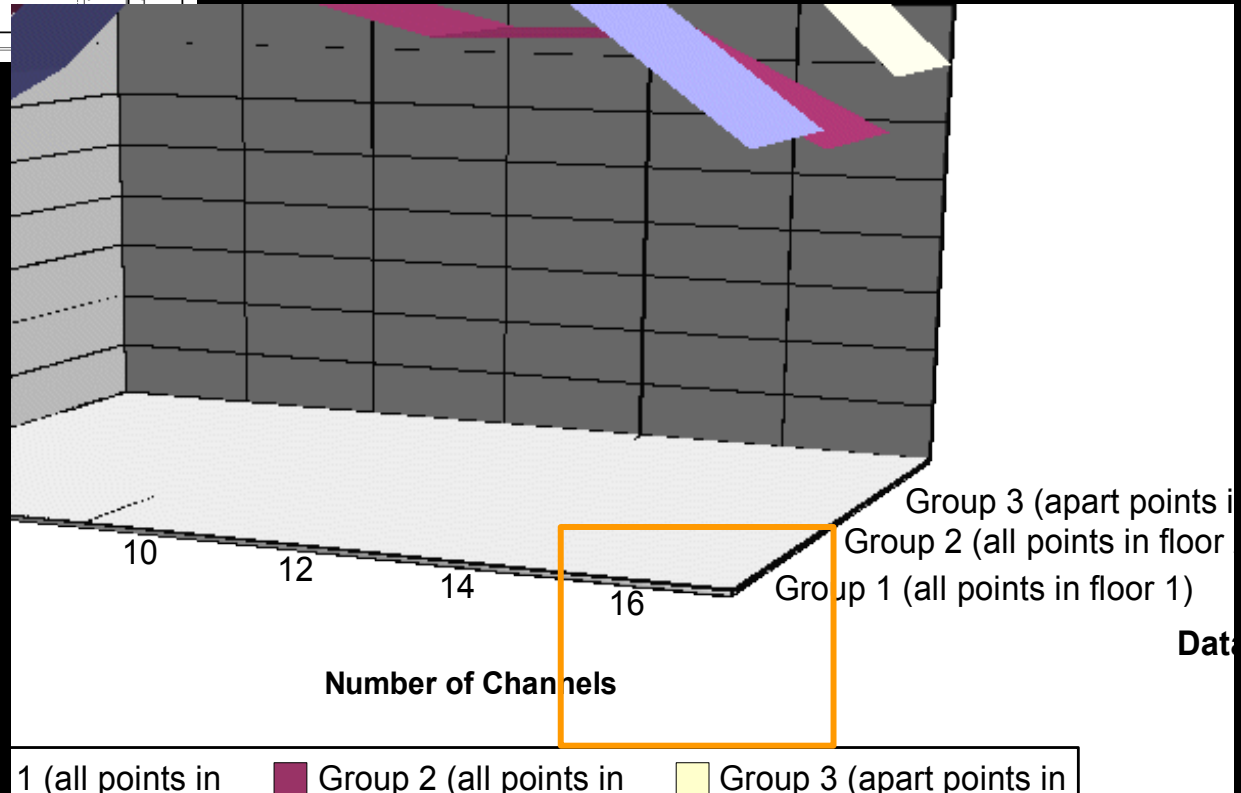
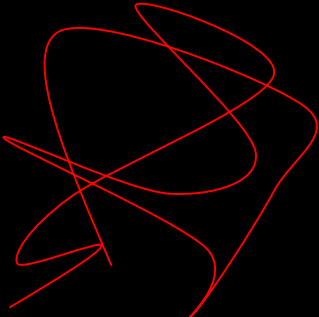
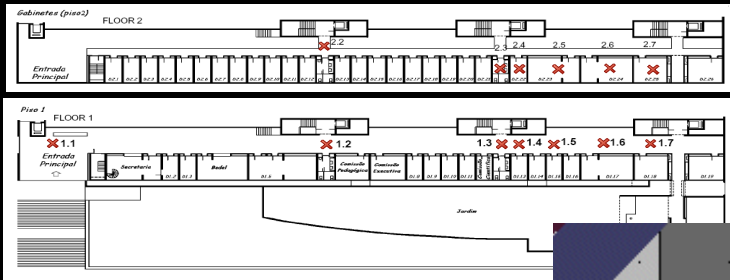
## Indoor location using GSM or WiFi signatures



# Research



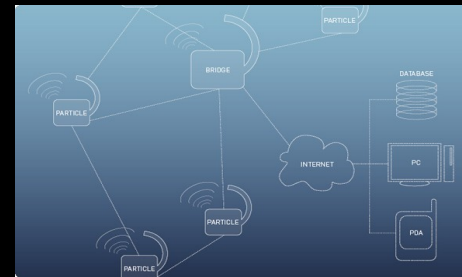
## Indoor location using GSM or WiFi signatures





## Indoor location in a network of particle computers

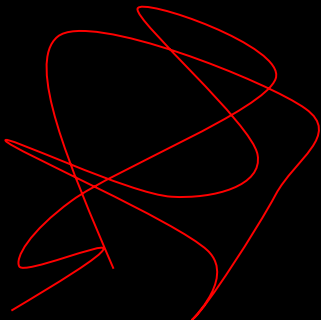
- Particle computers are sensor node networks (motes)



- There are other “brands” (DustNetworks, SunSpots, CrossBow, ScatterWeb, etc.)

- They have been used for many applications:

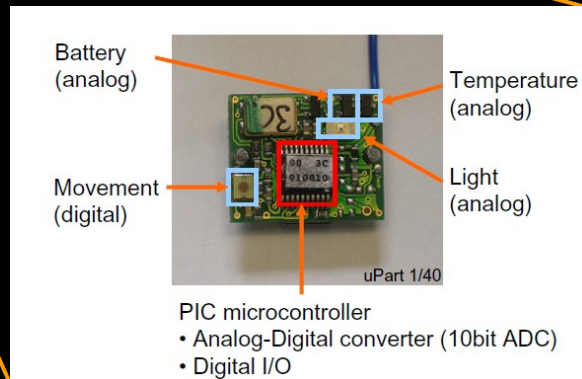
- Industrial Monitoring
- User interface
- Localization



# Research

## Indoor location in a network of particle computers

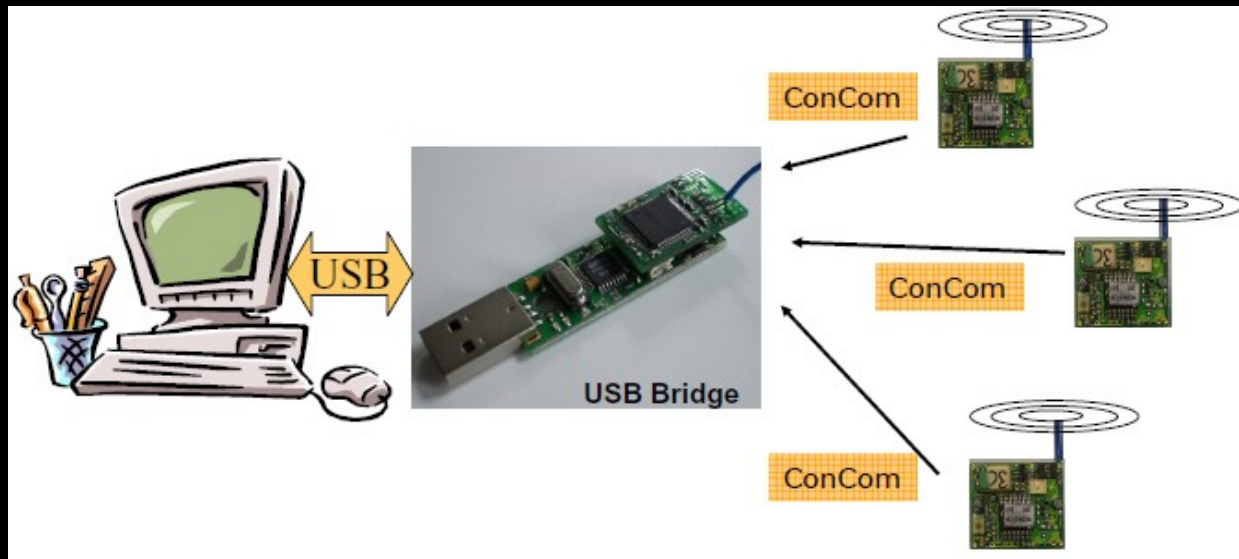
- Using uParts (senders) and Bridges (receivers), we can localize babies and mothers, check their co-location...



# Research

## Indoor location in a network of particle computers

- Using uParts (senders) and Bridges (receivers), we can localize babies and mothers, check their co-location...





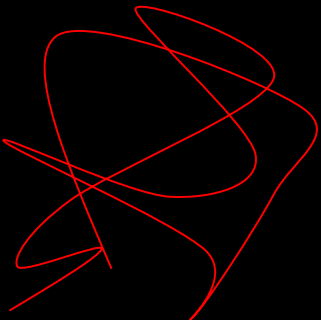
# Research



Indoor location in a network of particle computers

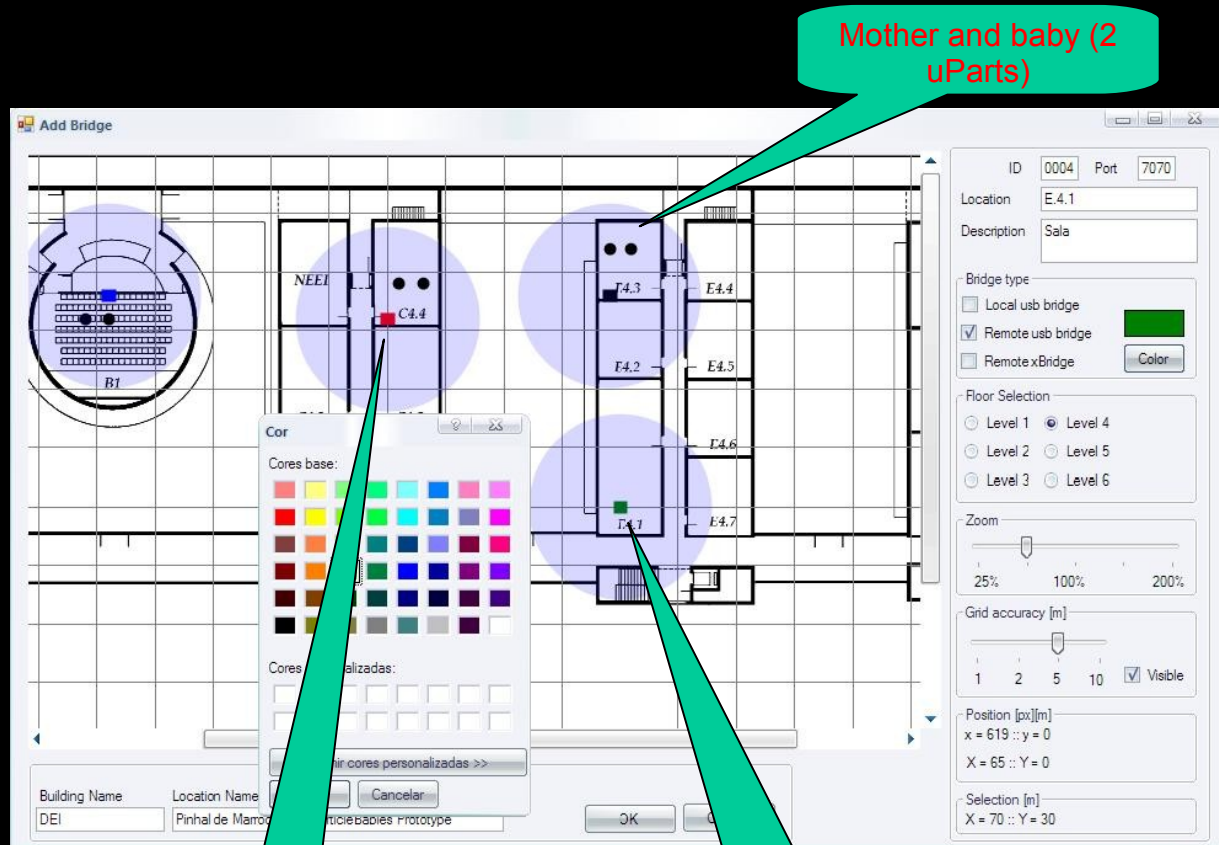


- We're learning the technology with a simple project (Particle Babies – **Baby localization** and **Security** in a Nursery environment)



# Research

## Indoor location in a network of particle computers



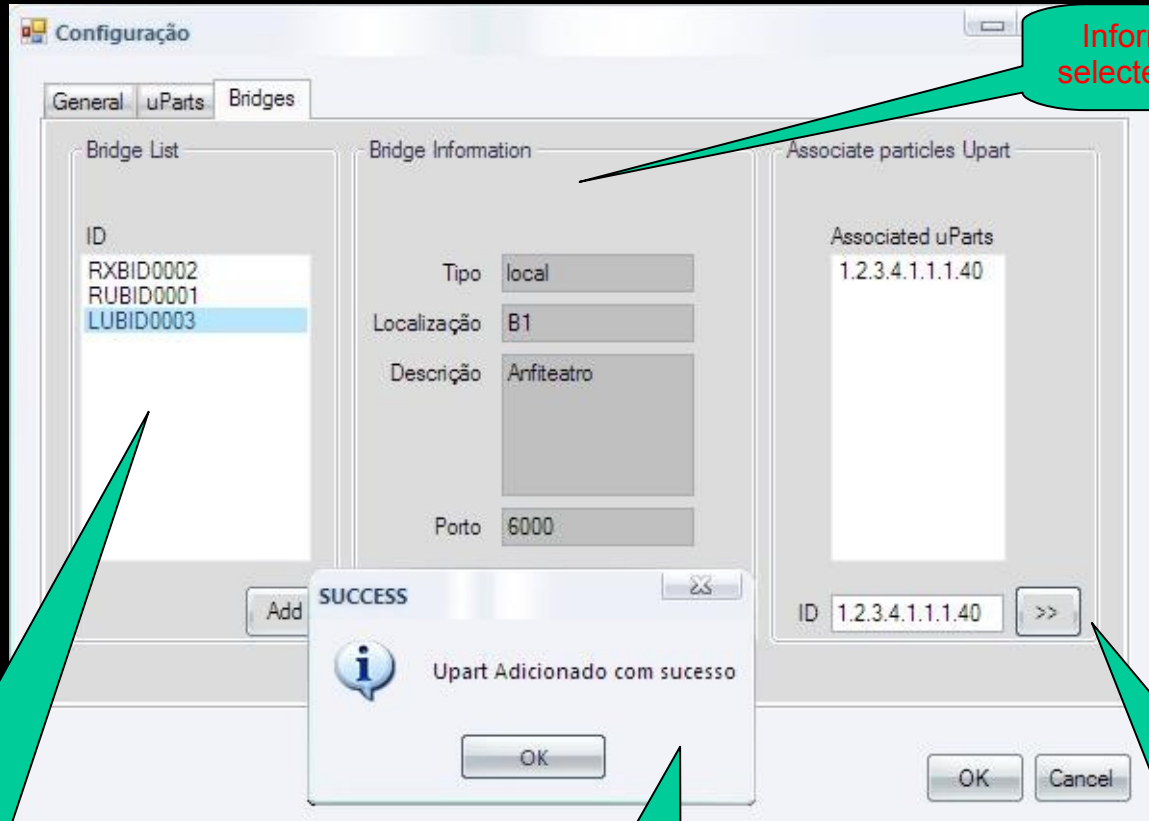
Mother and baby (2 uParts)

USB bridge

Another USB bridge (each one has a different color)

# Research

## Indoor location in a network of particle computers



Information on the selected USB bridges

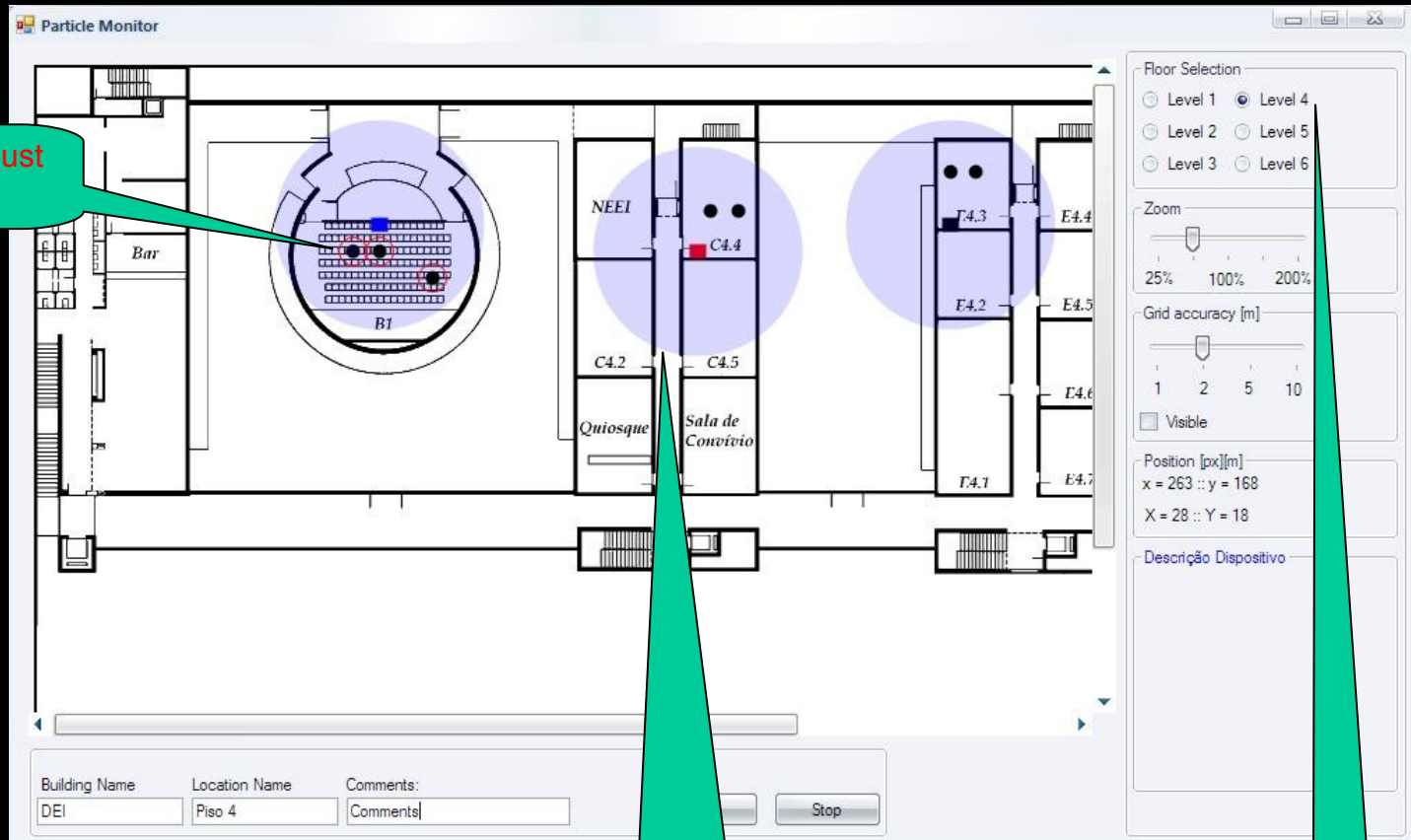
Available USB bridges

Successful association of a uPart to a USB bridge

Association of a uPart to a USB bridge

# Research

## Indoor location in a network of particle computers



These 3 uParts must come together!

USB Bridge range

4th Floor



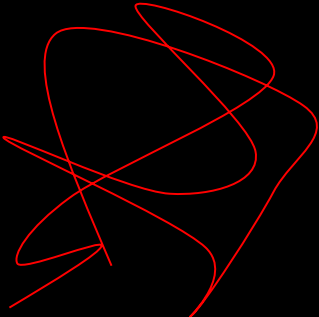
# Research



## From position to place: Taxonomy for location (Dobson)



1. At 53° 4'N, 1° 17'W (absolute position)
2. In A1.15 (named space)
3. In a conference room (named class)
4. In his (Waldo's) office (subject static space)
5. In his car (subject dynamic space)
6. In Widget and Sons' offices (related space)
7. At 1000 he will be . . . (in the future)
8. At 0800 he was . . . (in the past)
9. Near/Within . . . metres of . . . (in vicinity)
10. Between... and... (onpath)
11. Eitherat... or... or... (discreteset)
12. His badge/phone was last seen at . . . (by proxy)
13. At this time he is usually . . . (by default)
14. Not . . . (by negation)
15. Out/on holiday (non-located task)
16. No idea (unknown)



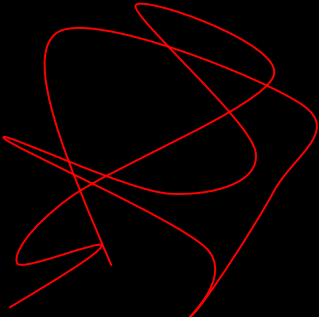


# Research

Information retrieval driven by  
places and physical browsing

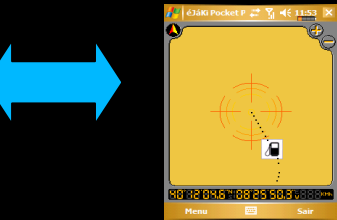
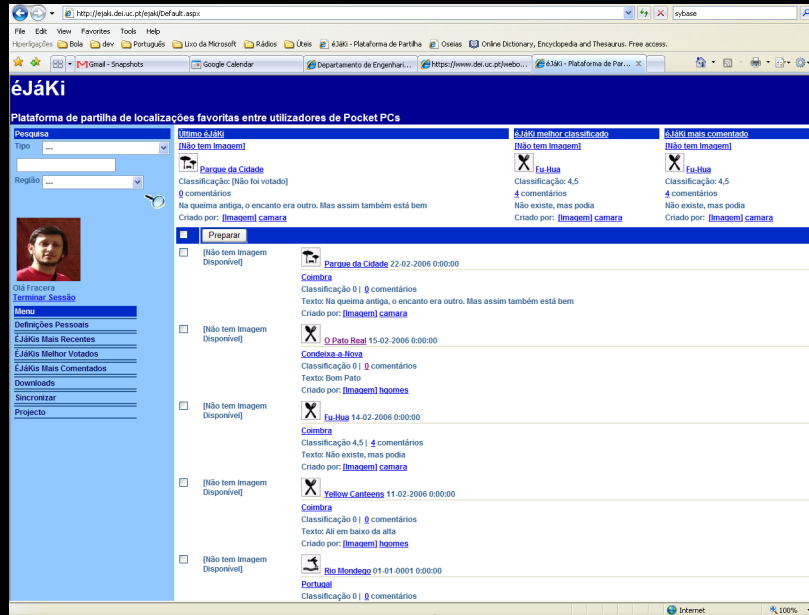


1. **At 53° 4'N, 1° 17'W (absolute position) << GPS**
2. **In A1.15 (named space) << annotations**
3. **In a conference room (named class) << annotations << semantic info**
4. **In his (Waldo's) office (subject static space) << indoor location << anotations**
5. **In his car (subject dynamic space) << proximity location e.g. BT**
6. **In Widget and Sons' offices (related space) << indoor location << anotations**
7. **At 1000 he will be . . . (in the future) << user modelling**
8. **At 0800 he was . . . (in the past) << user logs**
9. **Near/Within . . . metres of . . . (in vicinity) << proximity location e.g. BT or UParts**
10. **At this time he is usually . . . (by default) << user modelling**



# Research

## From position to place: EJAKI





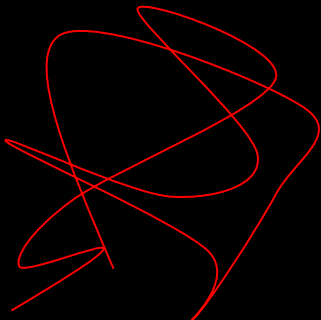
# Research



From position to place: EJAKI



- A community platform for sharing POI
- Follows the community dynamics philosophies of projects such as Hi5, Orkut, Metacafe, YouTube...
- To be deployed soon... :-) Currently being tested...
- Engineering and technology learning goals at a first stage...
- ...scientific research on the following stages





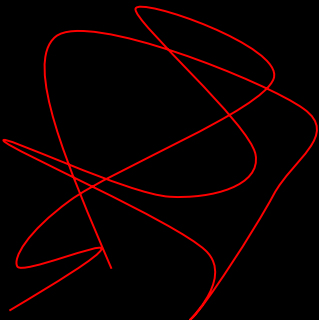
# Research



From position to place: EJAKI



- Scientific research open ends:
  - Semantic labeling of places. Originally, known as “position to place” problem. In Ejakis there already exist labels. But what's their meaning?
  - The constant use of GPS could help building a “map of the world”. Following the same principles of Ejakis... the “Eporakis”!





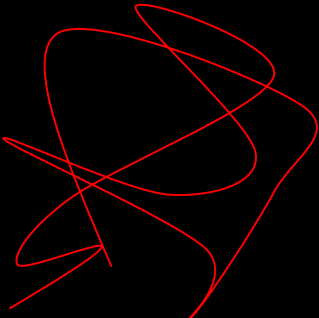
# Research



From position to place: EPORAKI



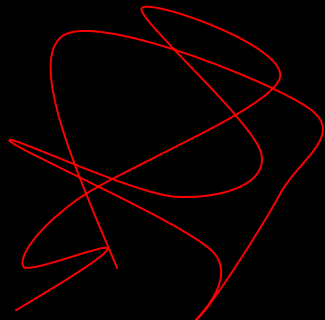
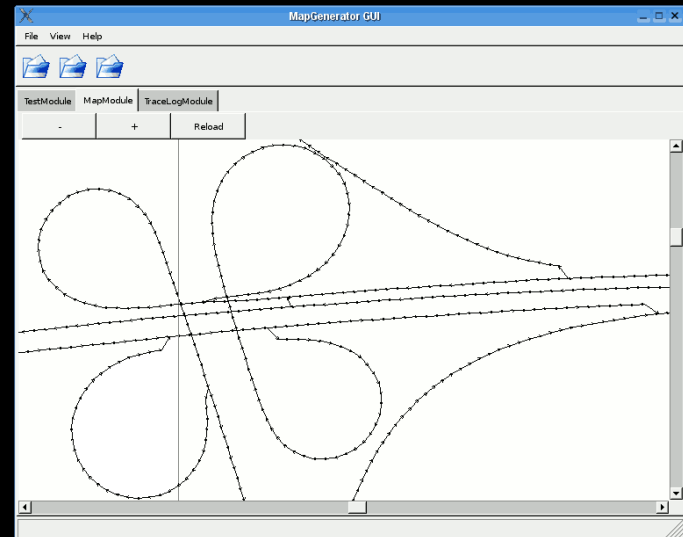
- What about sharing routes?
- If we use the Ejaki community philosophy, we can imagine a constantly up-to-date navigation system for free!!
- Challenge:
  - To merge each new route into the “world map” (learn it)
  - To understand special features from the datasets (e.g., gas station, traffic lights, bottlenecks, etc.)



# Research

## From position to place: EPORAKI

- There is already some work done from others (U. Dortmund)
- The Map Generation project
- The GPS infrastructure is almost built! ;-)





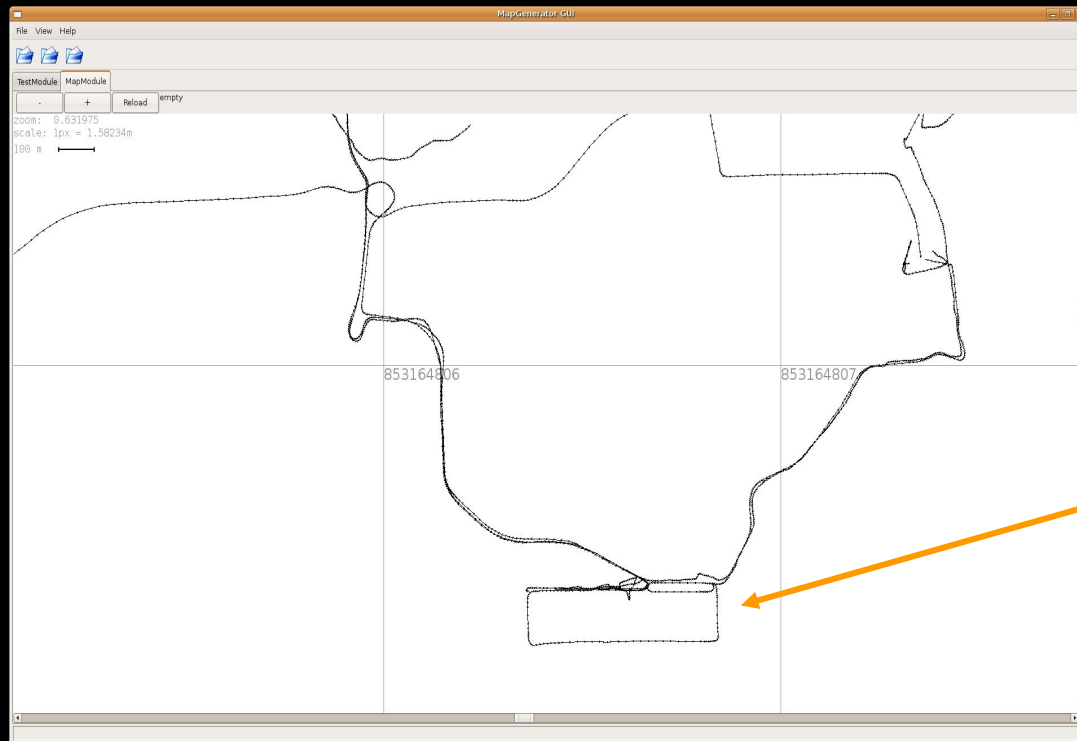
# Research



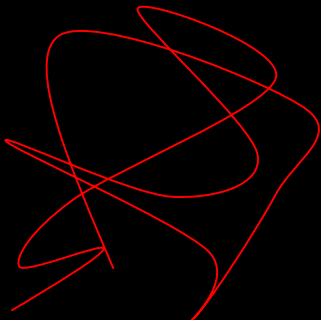
From position to place: EPORAKI



- Currently adding logs from the Ejaki client to the map database



Polo II :-)





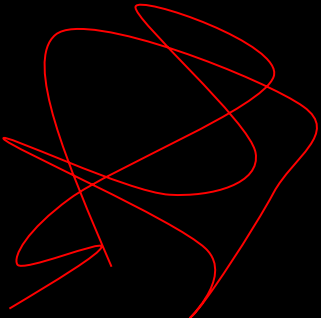
# Research



From position to place: EPORAKI



- Integration of Eporaki
  - PDA navigation in the map
  - Use the sharing platform to share and vote routes...
  - Route planning





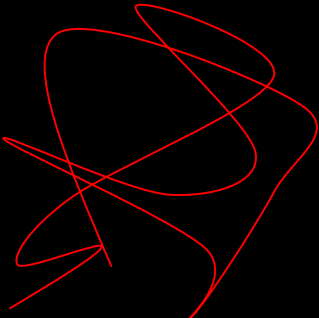
# Research



From position to place: EPORAKI



- Science open ends...
  - Detect special features (traffic lights, parking spaces, gas stations...)
  - Integrate Ejakis in the map, thus building a tagged map
  - ...





# Research

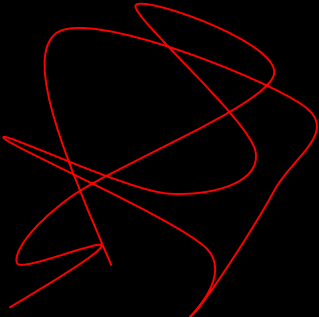


From position to place  
Semantic Enrichment of Place (Ana PhD)



Questions

- Using a mobile device (PDA, cell phone, notebook, ...)
  - Where am I?
    - Different answers to the same place:
      - I am at position -73.94470, 40.79180
      - I am in Madison Av., New York, NY, 10029
      - I am next to Mount Sinai
      - ...
  - What is the purpose of this place?
    - Background Semantic knowledge
      - Medical Institution
      - Hospital
      - Gastroenterology
      - Hepatology





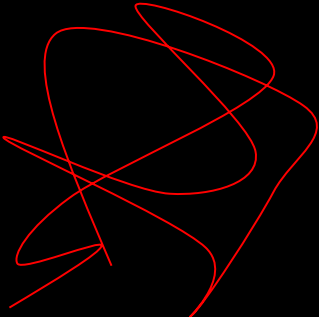
# Research

From position to place  
Semantic Enrichment of Place (Ana PhD)



Preamble

- Position to Place Problem
  - Global Position (X,Y)
    - Very precise
    - Easy computer processing
    - Poor information
  - Geographical Address
    - Better human-readable information
    - Still missing which type of place it refers to
  - Symbolic Location
    - Evolving set of both communal and personal labels





# Research

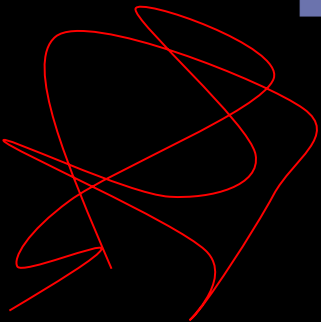
From position to place

Semantic Enrichment of Place (Ana PhD)



*Symbolic Location Modelling*

- Advantages
  - Identified by a name or a concept
  - Can be used to infer other related concepts
  - Hierarchically organized
  - Very convenient to human interaction
- Disadvantages
  - Unavoidable manual construction
  - Management of the names
  - Dependence on the application domain
  - Restrict spatial resolution





# Research

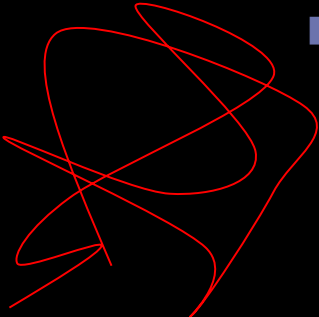
From position to place

Semantic Enrichment of Place (Ana PhD)



Free available resources

- Ejaki database (soon available)
  - POI containing label and position of a place
- WordNet
  - Semantic taxonomy of concepts
- Wikipedia
  - Free collaborative encyclopedia
- World Wide Web (as last option)
  - Web mining for a unknown place (missing from WordNet and Wikipedia)





# Research

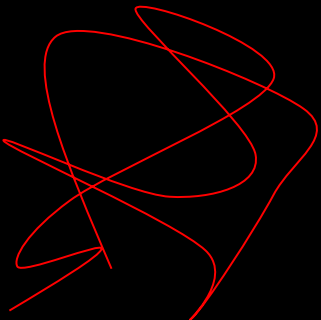


From position to place  
Semantic Enrichment of Place (Ana PhD)



## Challenges

- How can we use and integrate these resources to infer the “meaning of place”?
- After this, is it possible to search for the nearest semantic related places?
- Finally, knowing the meaning of the favorite places given a user, can we help him in proactive way?





# Research

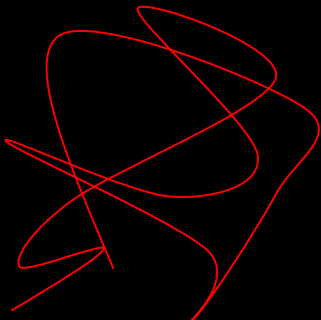


From position to place  
Semantic Enrichment of Place (Ana PhD)



Our Approach

- Construct a Hybrid Location Model with:
  - Global Position
    - Useful to find close places
  - Symbolic Location
    - Essential to know the meaning of the place
  - ( LAT, LONG, Name, Category)
  - (-73.94470, 40.79180, Mount Sinai, “”)
  - (-73.95300, 40.80190, “”, pharmacy)
  - (-50.87659, -30.78595, “St. Catherine's”, tourism)





# Research

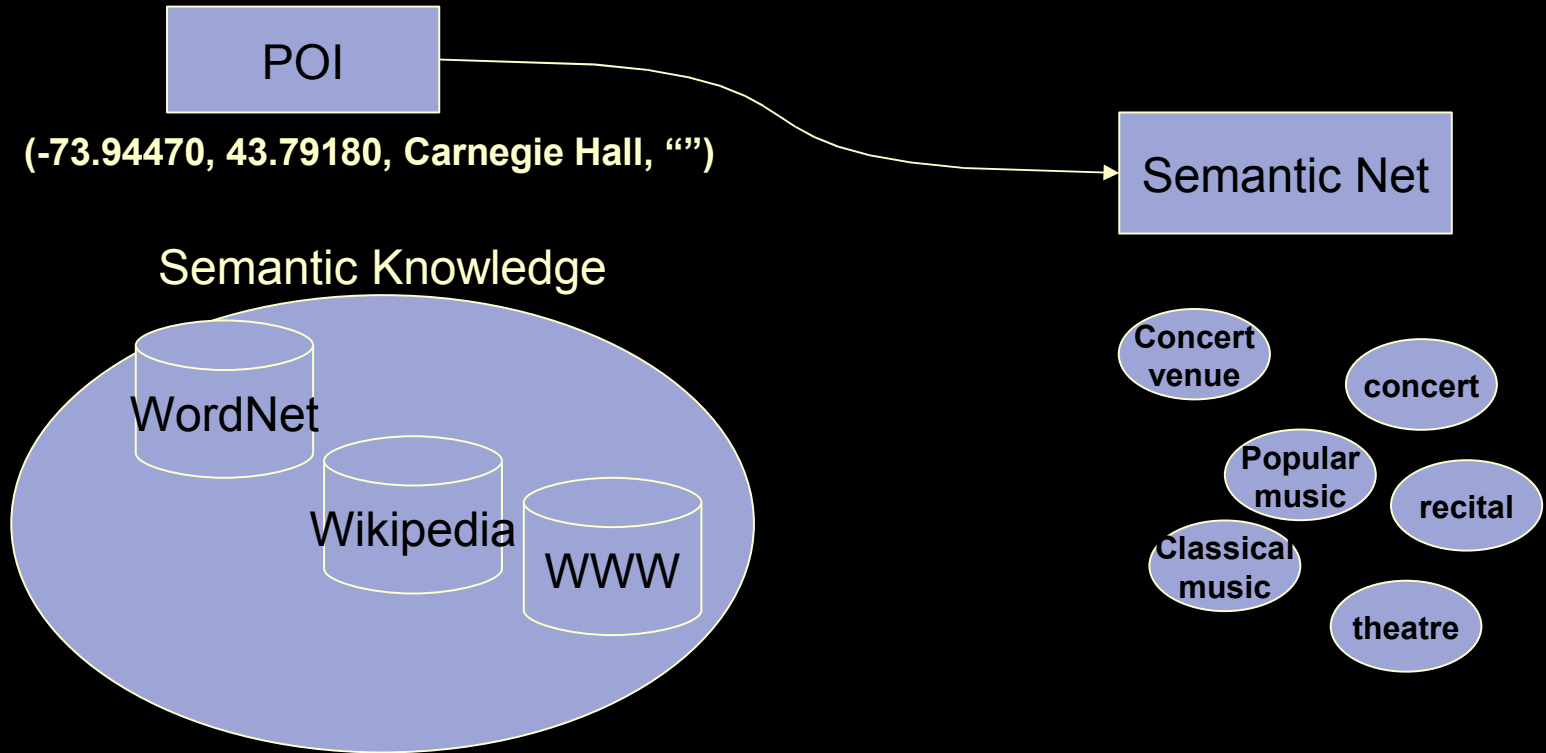
From position to place

Semantic Enrichment of Place (Ana PhD)



Our Approach

- Represent Semantic Meaning of a Place:

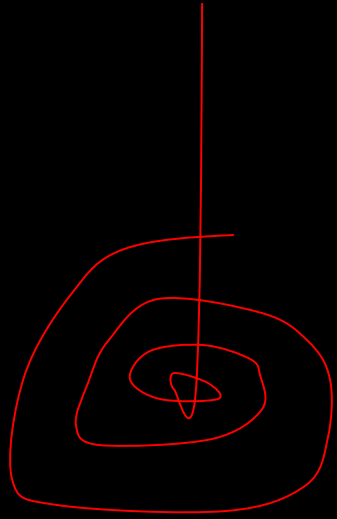
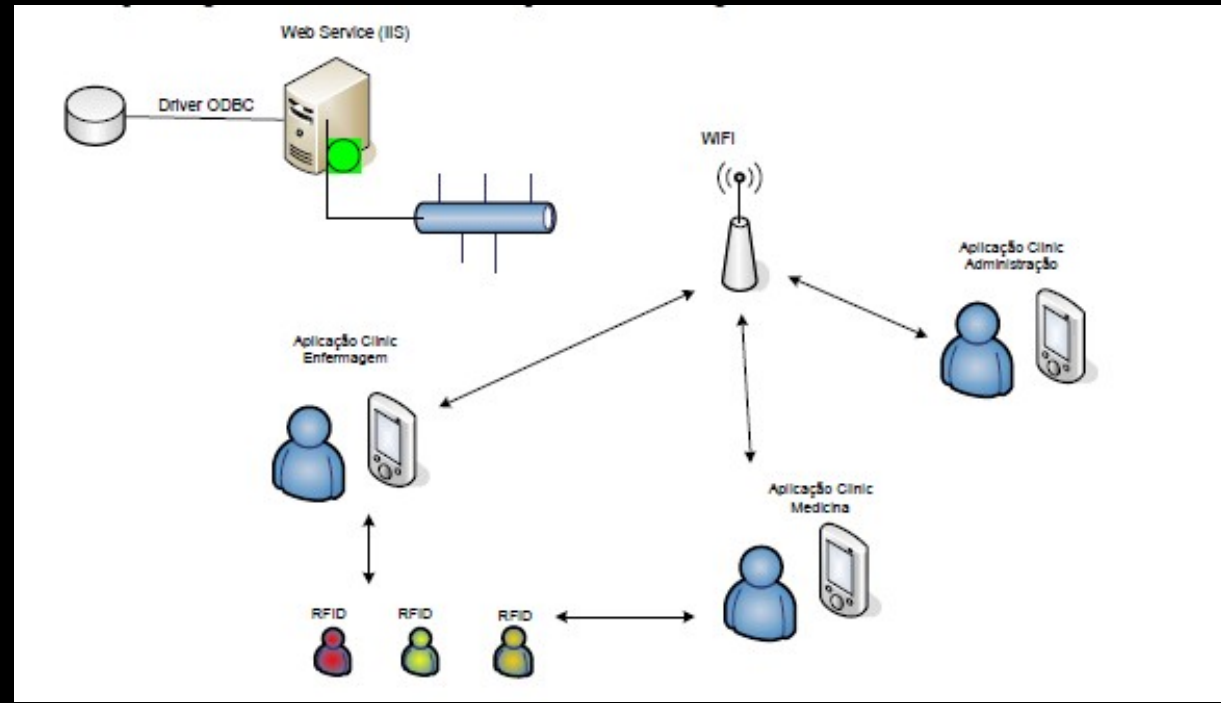




# Health Care Projects



Information Retrieval supported on Physical Browsing





# Health Care Projects



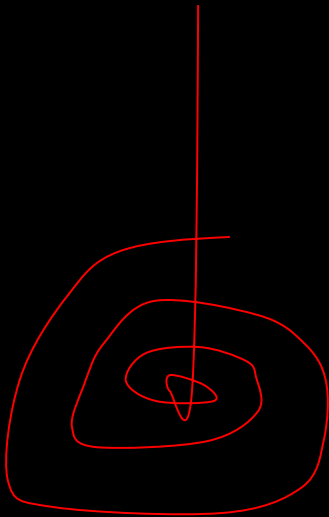
Information Retrieval supported on Physical Browsing



RFID reader



RFID reader





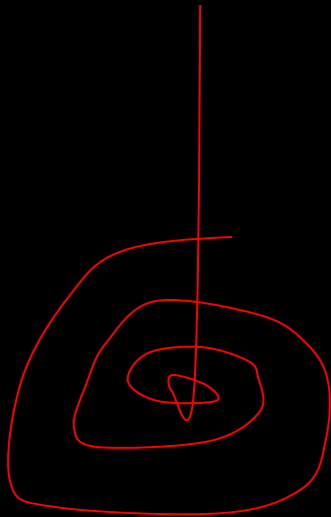
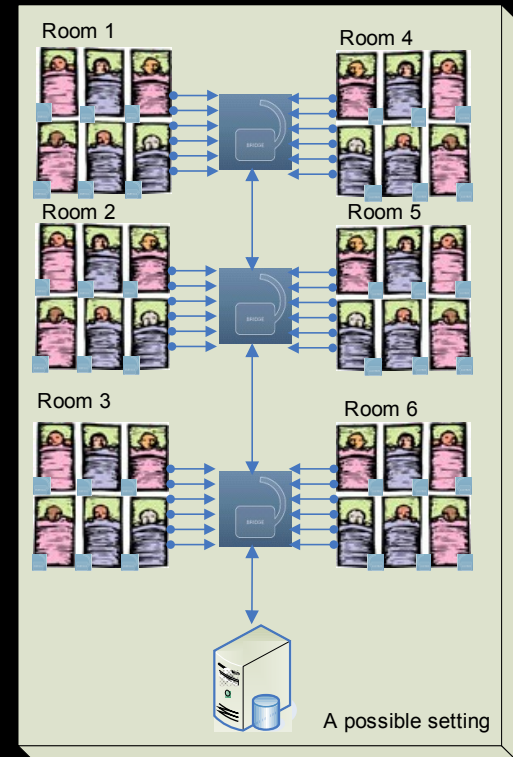
# Health Care Projects

Security – Particle Babies



**Development of a security system in collaboration with the largest nursery hospital in Lisbon**

**(Maternidade Alfredo da Costa)**





# Health Care Projects

MedicineOne HomeCare



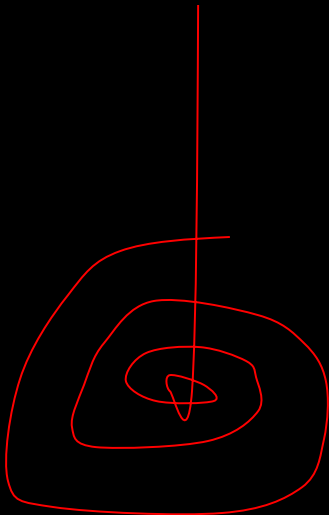
Portable Nurse Assistant

Contextual Information Retrieval (doctor appointments, therapy, protocols)

Collection and analysis of biometric data

Information Retrieval on pathologies, drugs, and acceptable parameters

Alarms on critical clinical situations





# Health Care Projects

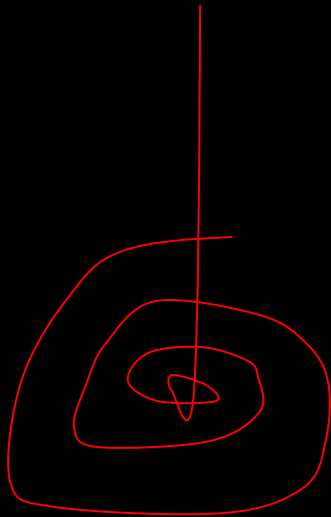
MedicineOne Link



Location based services (finding the closest specialist)

Digital object streaming (3G and WiFi)

Warnings (post-its) contextualized by location





# Partnerships

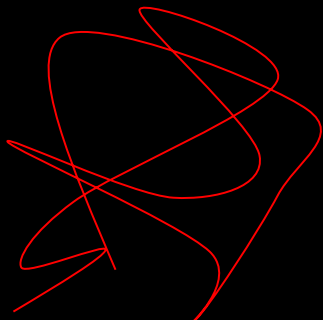


**Departamento de Engenharia Informática  
Univ. de Coimbra**

**Ideias Sem Fim, Lda**

**Instituto Pedro Nunes**

**Universidade do  
Minho**



**Intel Research Seattle**

**Project MAVIR**



# Potential for MAVIR



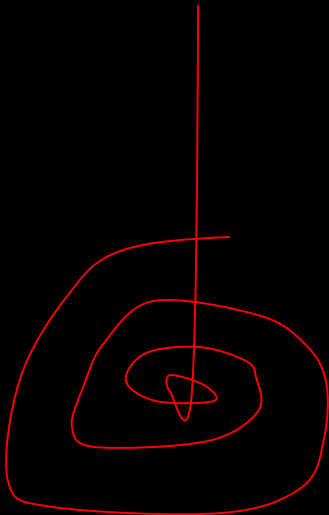
Information retrieval supported on enriched place semantic and physical browsing

Ontologies for places and objects

Using multiple sources for place annotation or text indexing (Wordnet, Wikipedia, WWW, etc...)

Development of applications for HealthCare and Cultural Spaces

Sharing of experiences on deployment of applications on real scenarios

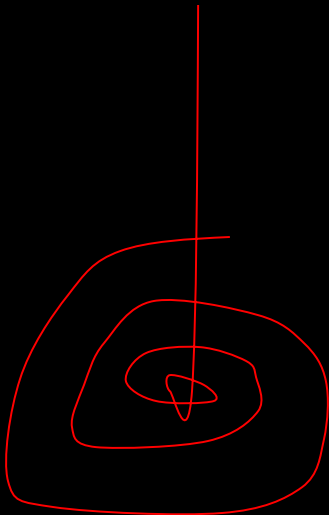




# I Jornadas MAVIR



**Muchas Gracias**



**Email:** [bento@dei.uc.pt](mailto:bento@dei.uc.pt)



**cmlbento**