IoT Week 2022

Contribution of a simple geolocation symbolic system in the framework of E-health

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12/10/2022

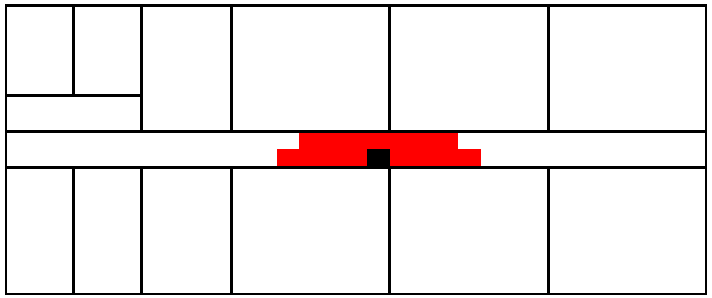
A different way to deal with positioning: the "symbolic" approach

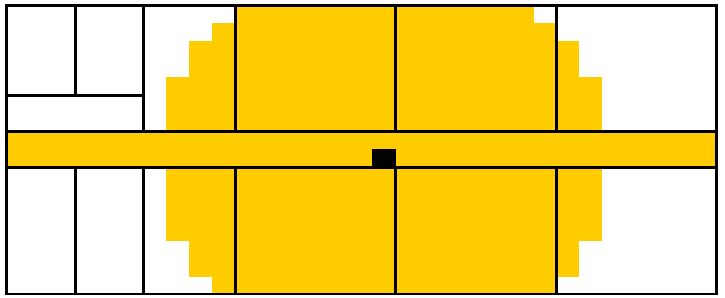
→reliable rather than accurate

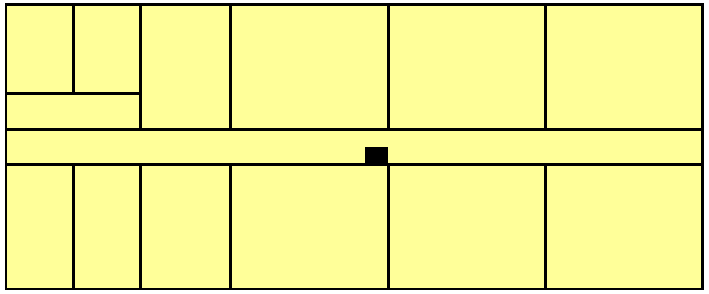
- ***RSSI*** based method
- Definition of 2 ***thresholds***
- Leading to 3 coverage ***areas*** of High probability of presence (highly reliable)

Fundamental aspects

- ***Overlapping*** areas
- Taking into account the ***map***







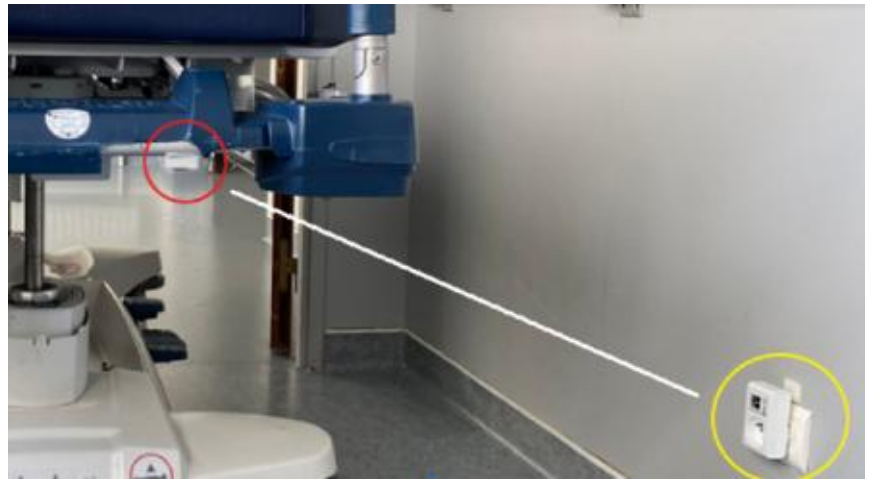
Current implementations – Radio signals

It is a BLE Tag that is followed

But it could be a smartphone or a watch

Through plug-in modules that receive the BLE and transmit in WiFi

Here on a stretcher



Current implementations – The map

Mapping is a fundamental element:

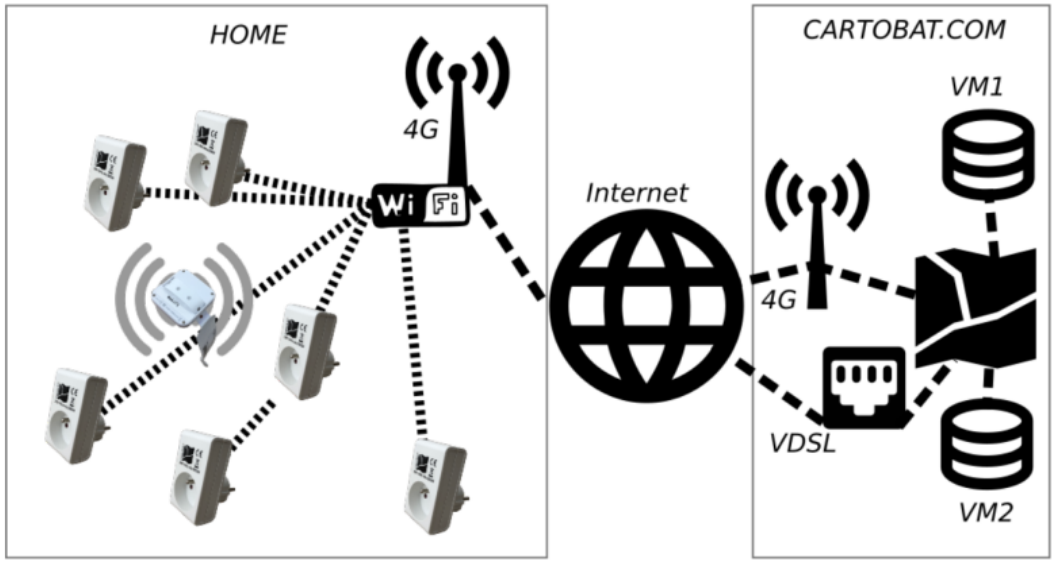
- which includes the position of the plug-in modules
- which will be taken into account in the positioning algorithm

Hospital

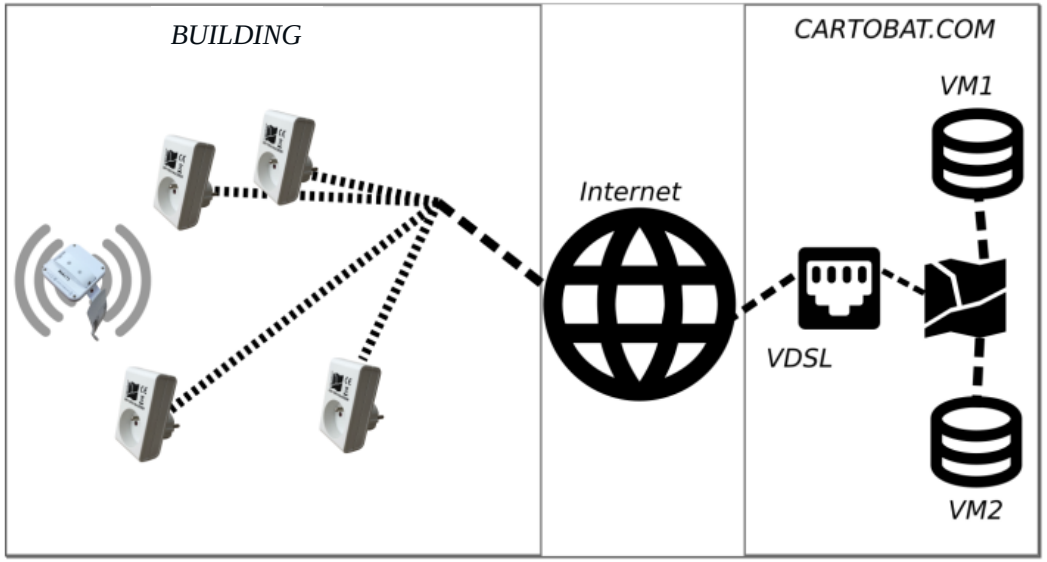
Home

Office building

Current implementations – Network aspects



An autonomous network for the house



If there is an installed WiFi network

Current implementations – Available Data

Several types of data are available:

- monitoring of BLE and WiFi transmissions

Site: SilverLab CartoWear: 399F

Module	Last Wifi Update (s)	RSSI Wifi (dBm)	Last Wear Update (s)	RSSI Wear (dBm)
AC67B27700D2	9	-65	3	-79
AC67B276FF26	9	-54	9	-75
AC67B277006E	54	-65	11	-70
AC67B277005A	4	-55	110	-48
AC67B275C5D2	21	-52	6	-74
AC67B276FEE6	2	-64	1	-73
AC67B2770026	17	-52	1	-74
AC67B2770032	28	-71	5322	-72
AC67B2754CEE	124	-84	460	-79

- raw data on the BLE signal levels received by the plug-in modules

ID	timestamp	macModule	macWear	rssi
832451	2022-02-23 08:55:00.045	AC67B276F2C6	00FAB601A14C	-69
832452	2022-02-23 08:55:00.031	AC67B275C766	00FAB601A14C	-79
832456	2022-02-23 08:55:00.047	AC67B276F2C6	00FAB601A146	-67
832515	2022-02-23 08:55:00.331	AC67B2770046	00FAB601A1DC	-80
832516	2022-02-23 08:55:00.045	AC67B276F2C6	00FAB601A1DC	-64
832519	2022-02-23 08:55:00.325	AC67B2770046	00FAB601A1DF	-76
832522	2022-02-23 08:55:00.046	AC67B276F2C6	00FAB601A1DF	-57
832523	2022-02-23 08:55:00.033	AC67B275C766	00FAB601A1DF	-75
832770	2022-02-23 08:55:08.198	AC67B276F2C6	00FAB601A146	-76
832771	2022-02-23 08:55:10.161	AC67B2770046	00FAB601A146	-71
832773	2022-02-23 08:55:06.061	AC67B275C766	00FAB601A146	-75
832774	2022-02-23 08:55:10.325	AC67B276FF1E	00FAB601A14C	-78
832775	2022-02-23 08:55:07.897	AC67B2770046	00FAB601A14C	-77

- visualization of the position of the various tags

For which uses and purposes?

- *At home*
  - ✓ *detecting unusual behaviors*
  - ✓ *analyze a person's life habits ... to be more efficient in detecting unusual behavior*
  - ✓ *define criteria for typical activity*

- *At the hospital*
  - ✓ *optimizing ambulatory pathways*
  - ✓ *monitor some equipment*
  - ✓ *be able to predict the availability of materials and personnel's*

- *At the EPHAD*
  - ✓ *detect zone exits*
  - ✓*allow for resident security*
  - ✓*authorize the exit of "at risk" residents*

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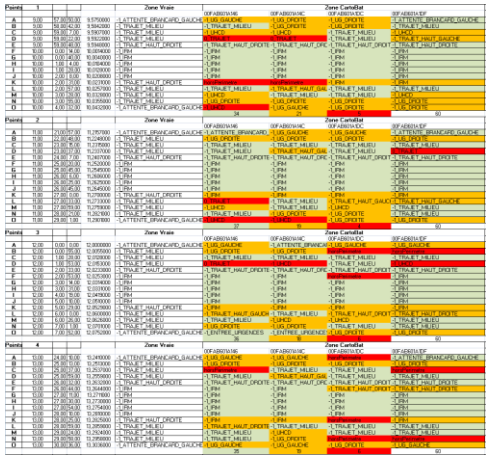
At the hospital

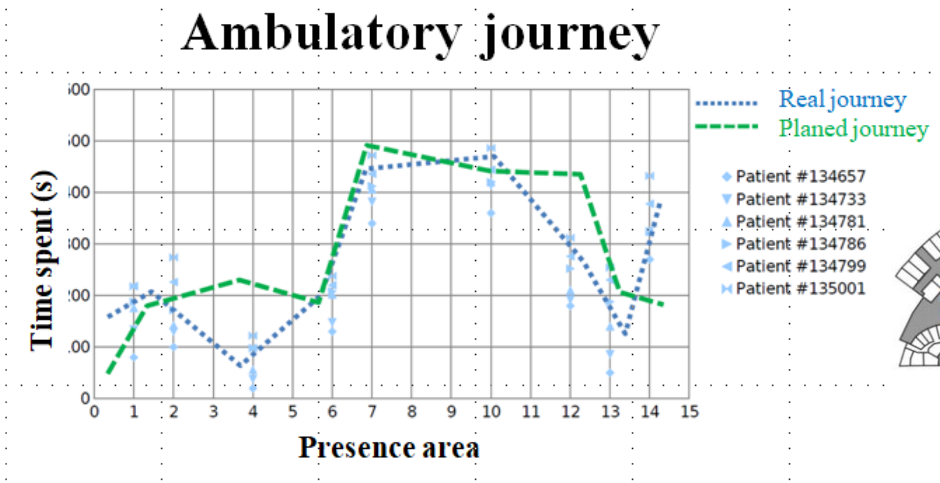
➢ Monitoring of stretcher movements

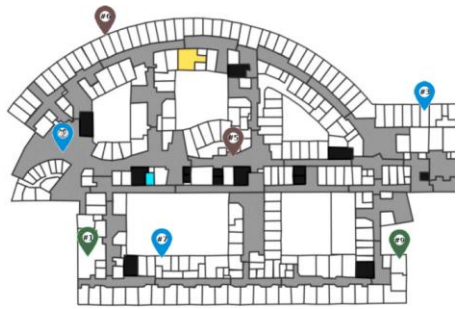


Destination service		Summary results			
		Green	*Orange*	*Red*	*Σ*
Imaging department 1	Nb points	190	98	12	300
	%	63	33	4	100
	Cumulative %	→	***96***	100	100
Imaging department 2	Nb points	176	82	42	300
	%	59	27	14	100
	Cumulative %	→	***86***	100	100
Imaging department 3	Nb points	273	75	52	400
	%	68	19	13	100
	Cumulative %	→	***87***	100	100
Imaging department 4	Nb points	350	131	39	520
	%	67	25	8	100
	Cumulative %	→	***93***	100	100
Σ	Nb points	989	386	145	1520
	%	65	25	10	100
	Cumulative %	→	***90***	100	100

➢ Prediction of travel times from one service to another

➢Analysis of ambulatory journeys





Points	Time	Real location	Travel time
			00FAB601A146
A	09:57:50	-1_ATTENTE_BRANCARD_GAUCHE	Real forward travel
B	09:58:42	-1_TRAJET_MILIEU	00:02:24
C	09:59:07	-1_TRAJET_MILIEU	Measured forward travel
D	09:59:22	-1_TRAJET_MILIEU	00:02:20
E	09:59:48	-1_TRAJET_HAUT_DROITE	Error
F	10:00:14	-1_IRM	00:00:04
G	10:00:40	-1_IRM	
H	10:01:04	-1_IRM	
I	10:01:28	-1_IRM	
J	10:02:08	-1_IRM	Real return travel
K	10:02:31	-1_TRAJET_HAUT_DROITE	00:02:24
L	10:02:57	-1_TRAJET_MILIEU	Measeured return travel
M	10:03:28	-1_TRAJET_MILIEU	00:02:30
N	10:03:55	-1_TRAJET_MILIEU	Error
O	10:04:32	-1_ATTENTE_BRANCARD_GAUCHE	00:00:06

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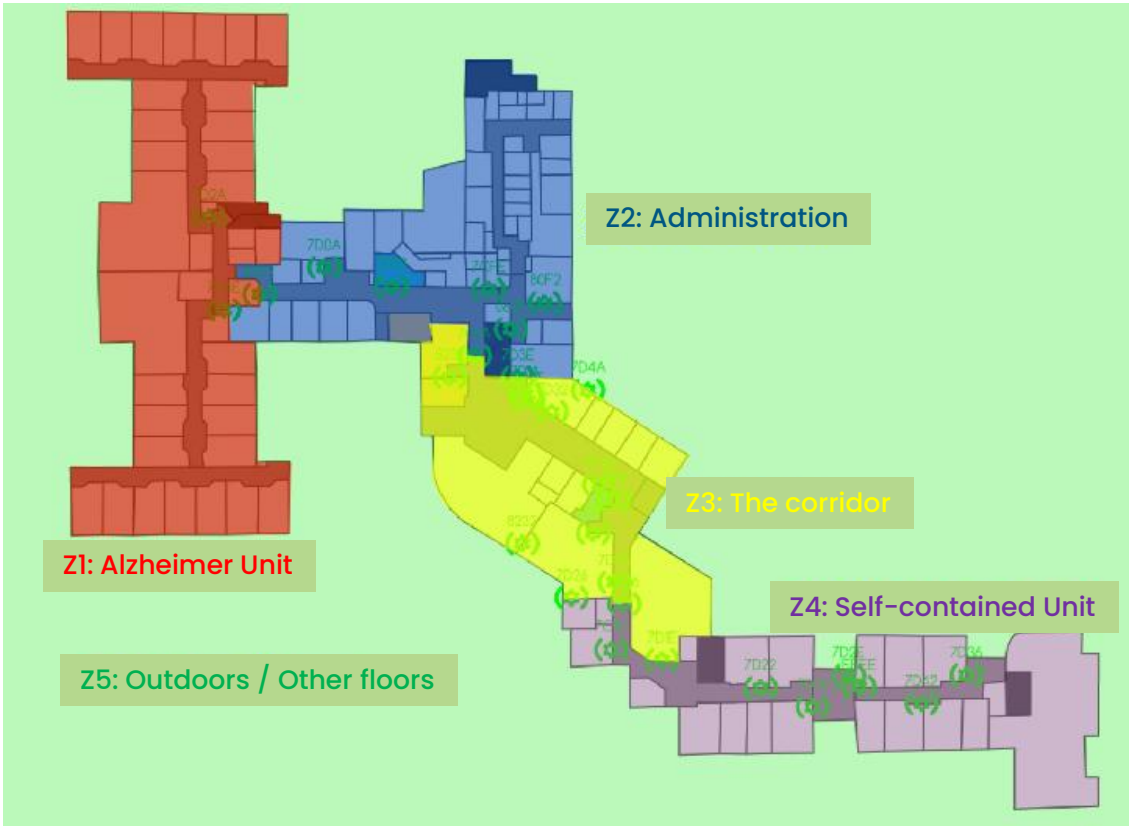
At the EPHAD

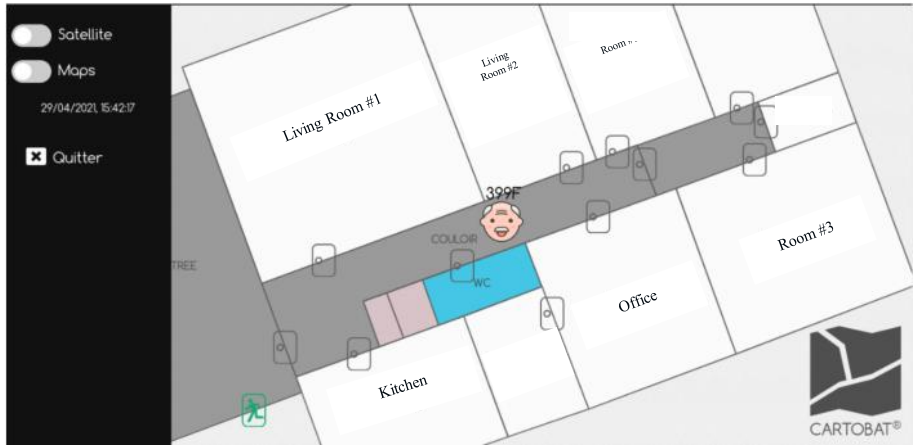
Accommodation facilities for dependent elderly people

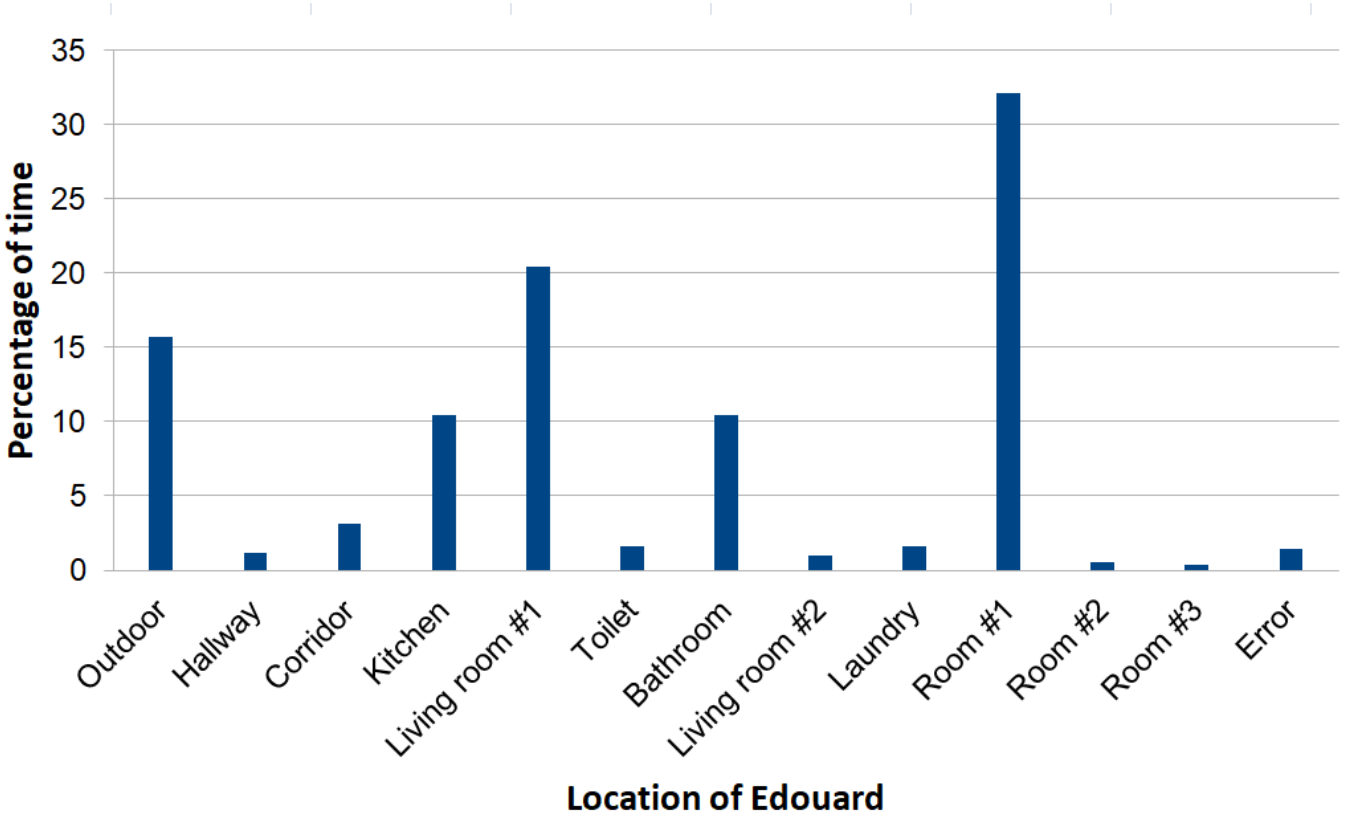
- Detection of a zone exit
- Reactivity in relation to an exit from the building
- Anticipation and security



At home

Authorized persons (doctors, family, ...) can access Edouard's position ...





The study of Edouard's average behavior can be used to define vigilance thresholds

Summary of the approach

- RSSI based method, not accurate (but reliable)
- Highly scalable approach depending on the real needs
- Requires the input of the building map including the position of the plug-in modules
- No need for a calibration phase for radio transmissions (which is paid for by the potential lack of precision)
- Potentially implementable with any kind of tags (smartphones, watches, ...)

Next steps

- Find new use cases and see if the symbolic approach is useful, interesting and possible
- Work on reducing the size and energy requirements of the tag
- Propose new positioning algorithms
- Carry out deployments in various environments and evaluate the approach

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THANKS FOR YOUR ATTENTION

12/10/2022