Context Awareness in Ambient Environments: Theory vs Practice

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dr. Maarten Weyn
maarten.weyn@artesis.be
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Probability is the very guide of life.
- Cicero

artesis

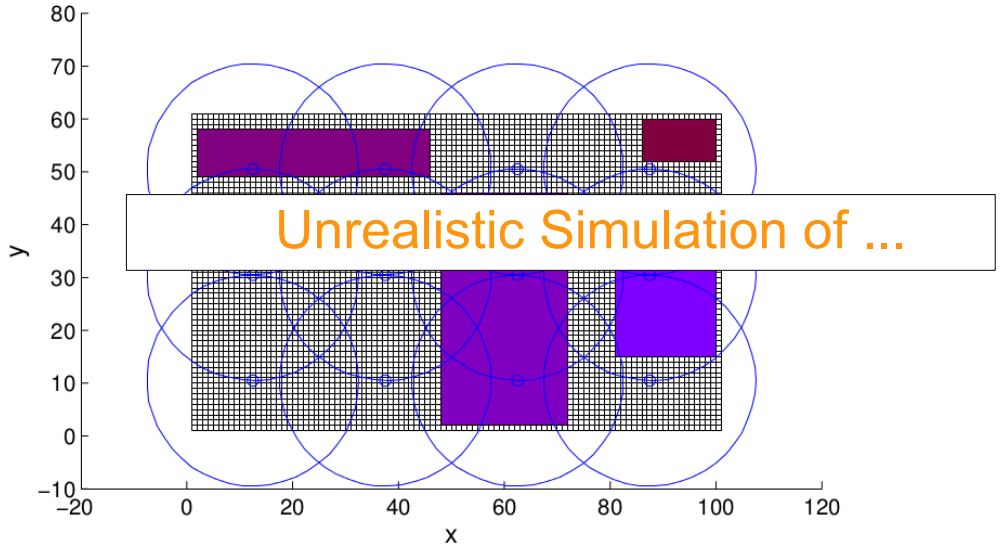
IARIA

industriële wetenschappen

Theory vs Practice

Prof. Dr. Jorge Garcia Vidal:

"Many research is based on unrealistic simulations far from reality"



… should …
… could …
… would ...

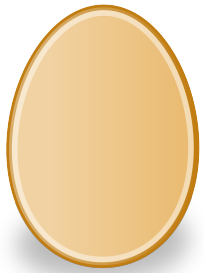
Fig. 2. A sample field with 5 logical locations: 4 shaded areas as 4 stores and white region is the hallway. 12 access points are placed on a grid with their communication range shown by the circles.

Ambient Intelligence

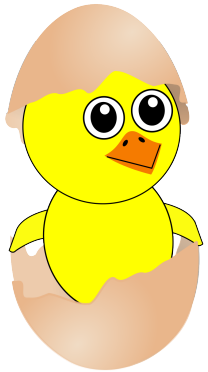
"Ambient Intelligence (AmI) is a vision of how ICTs will shape our future. It depicts a world of seamless intelligent environments, designed to understand and adapt to the presence of people and free them from manual control of their surroundings"

(Gunnarsdóttir and Arribas-Ayllon, 2011)

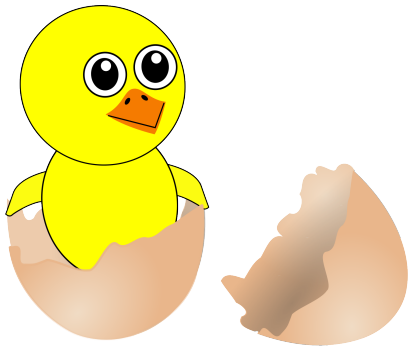
Ambient Intelligence



1998
From Devices to ‘Ambient Intelligence’:
The Transformation of Consumer Electronics
(Zelkha and Epstein, 1998, Philips).

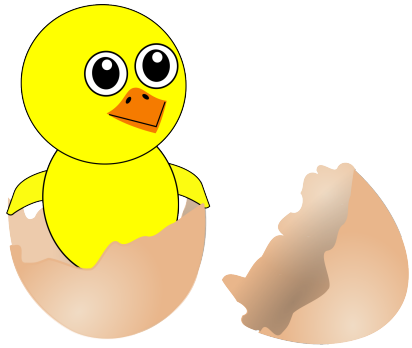


1999
The AmI vision drove the Europeans view on electronics research, engineering and materials sience.



2003
ISTAG, FP6

Ambient Intelligence



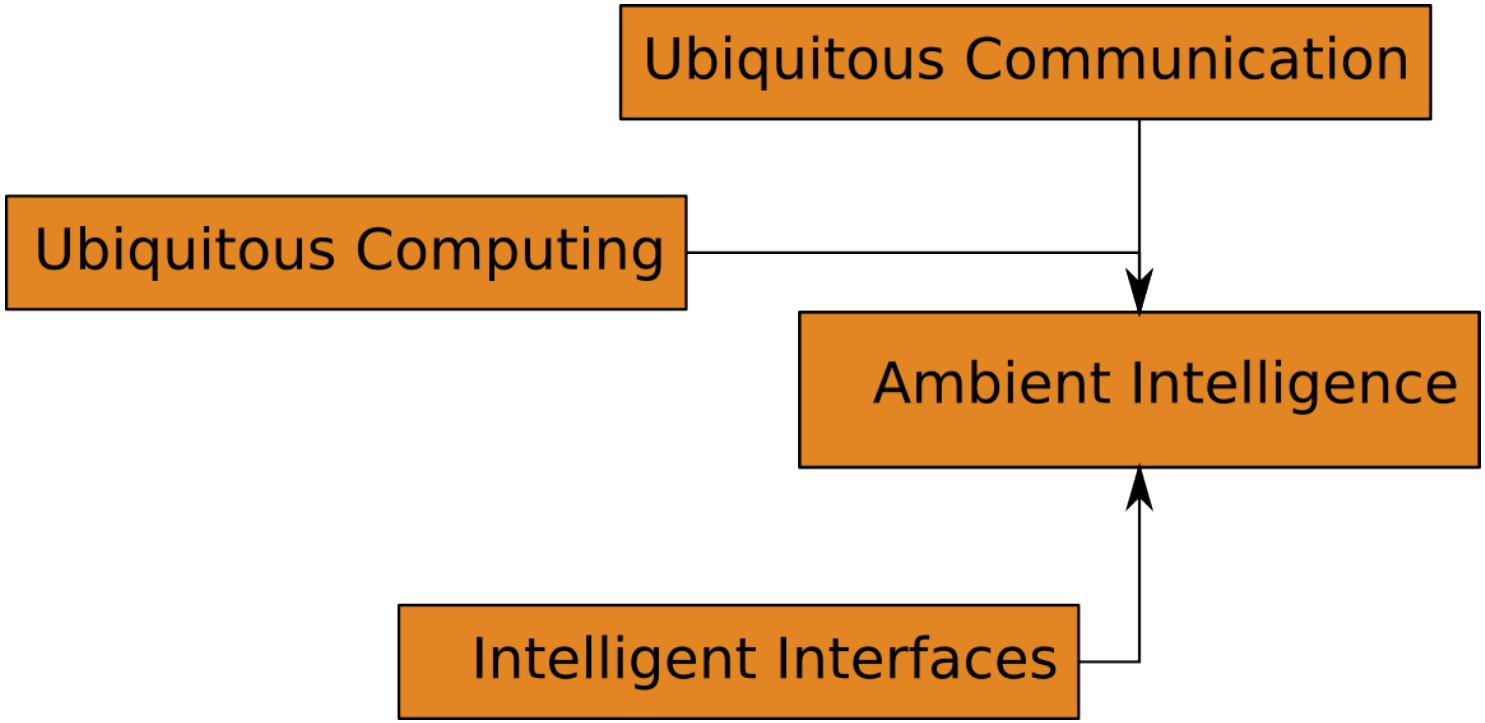
Now?

“We would expect to be witnessing the emergence of enduring principles and of a growing body of research findings and solved challenges.
Instead, much of the research effort still seems to be devoted to the creation, very often from scratch, of technologies and systems for enabling the scenarios described in the AmI vision”

(José et al, 2010)

Ambient Intelligence started out as...

A technology integrator



Source: EC

Ambient Intelligence started out as...

"The AmI vision was originally one of maximizing the potential of consumer electronics, telecommunications, materials science and computing, to support 'people and objects to interact with their environment in a seamless, trustworthy, and natural manner"

(Aarts and de Ruyter, 2009)

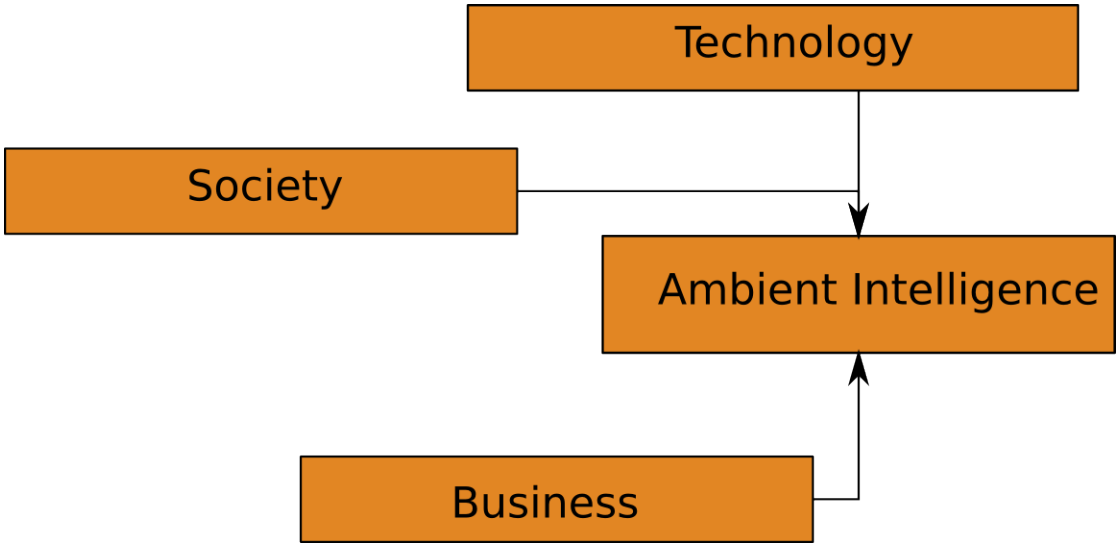
Laid-back rather than *lean-forward* mode

"Computing should 'move from an *explicit, instructional model* to an *implicit, anticipatory one*' with context aware, personalized, adaptive and anticipatory machine intelligence

(Gunnarsdóttir and Arribas-Ayllon, 2011)

Ambient Intelligence is moving towards becoming...

An innovation framework



Source: EC

Ambient Intelligence and Responsibility

The Telegraph

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HOME » TECHNOLOGY » GOOGLE

Lauren Rosenberg: US woman sues Google 'after Maps directions caused accident'

An American woman, Lauren Rosenberg, is suing Google, the search engine giant, because she was hit by a car after following its "safe" online mapping service.

Deer Valley Drive as seen on Google Maps Photo: GOOGLE

By Andrew Hough
8:15AM BST 02 Jun 2010

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The Los Angeles-based woman, who is in her mid 20s, is claiming damages from the internet giant because she was injured while taking a "safe" route recommended by Google Maps.

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Context Awareness

Context ?

Maarten Weyn
Artesis, Belgium

Opportunistic Seamless Localization

Probabilistic
Robotics
Ambient Intelligence
Digital Communication

Summer
10am - 12pm

Mattijs Weyn

3 years old
Son of Maarten Weyn

Context Awareness

“Context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and applications themselves”

(Dey & Abowd, 2000)

“A system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user’s task.”

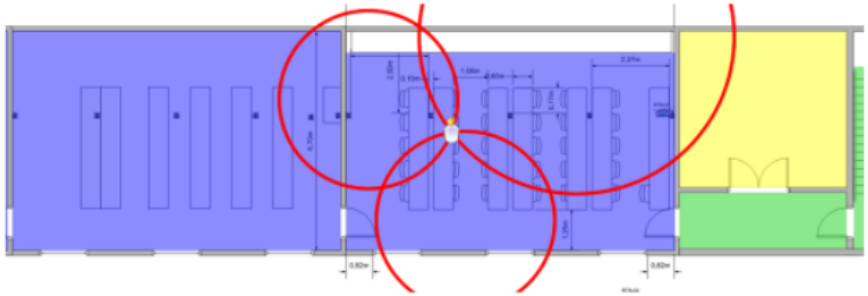
User Context

Any information that can be used to characterize the user and her situation

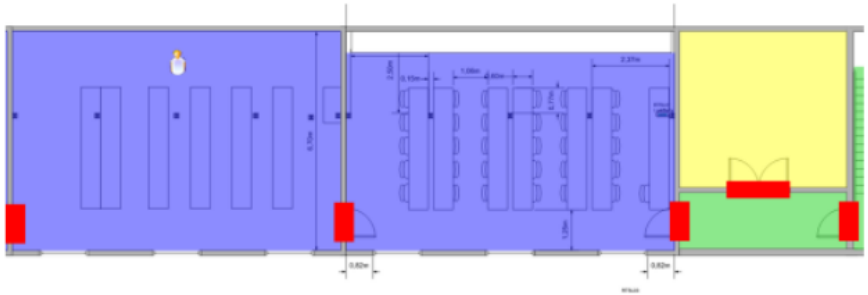
- Coming from sensors
  - Temporal and spatial location
  - Environmental attributes
  - Resources nearby
  - Physiological measurements
- User preferences and profile
  - Schedule, agenda
  - Social context

(Dogac, *et. al., 2003)*

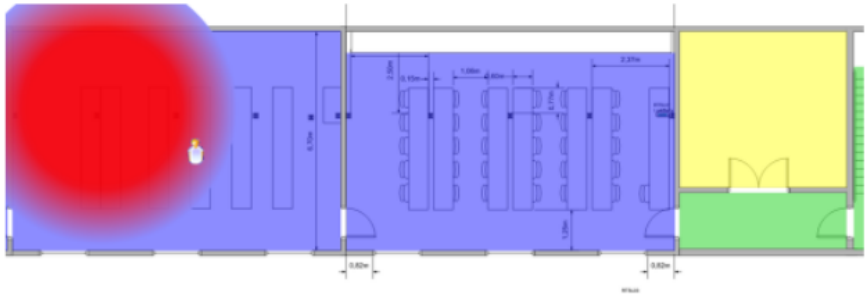
Location



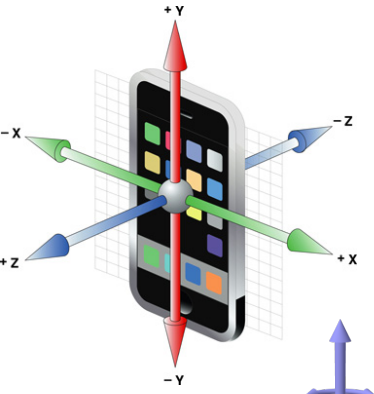
Full Locating (Coordinates)

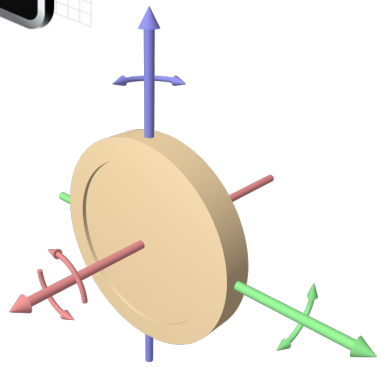


Chokepoints (Zones)



Presence / Proximity





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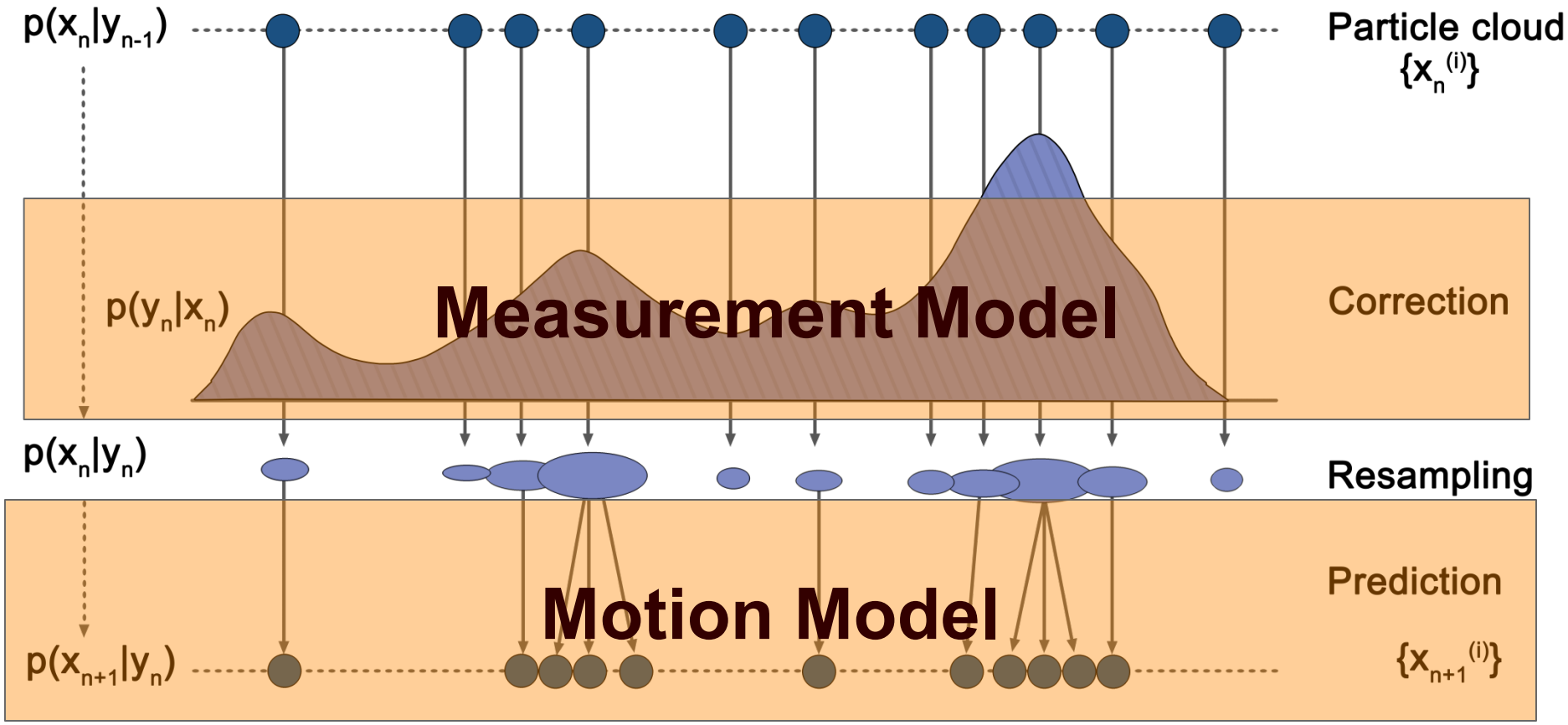
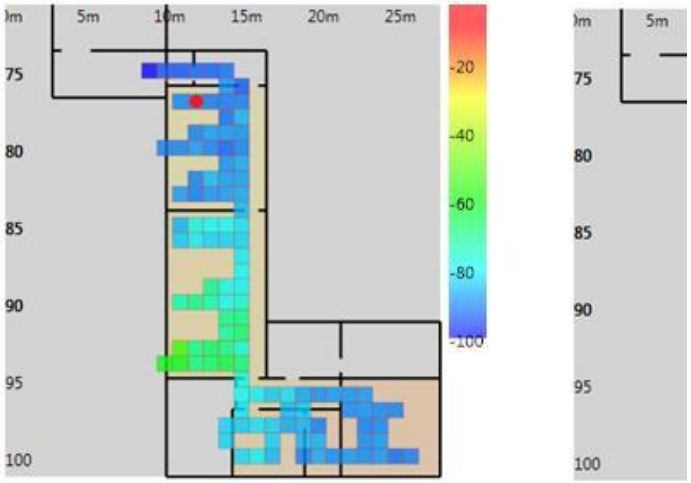
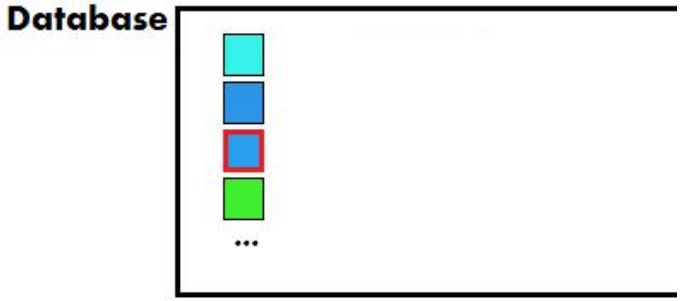
Particle Filtering



Wi-Fi Measurement Model

Pattern Matching





Algorithm 6: Difference_WiFi_Measurement_Model (z_t, x_t)

$w_{hit} = 1$

$w_{extra} = 1$

$w_{miss} = 1$

$w_{default} = 0.001$

get z_t^+ from fingerprint for $\mathbf{x}_t$

get RSS difference feature vector D for Hit

for all $d \in D$ **do**

  $w_{hit} = w_{hit} \cdot p_{hit}(\mathbf{z}_t^d | \mathbf{x}_t)$

end for

for all $e \in Extra$ **do**

  $w_{extra} = w_{extra} \cdot p_{extra}(\mathbf{z}_t^e | \mathbf{x}_t)$

end for

for all $m \in Miss$ **do**

  $w_{miss} = w_{miss} \cdot p_{miss}(\mathbf{z}_t^m | \mathbf{x}_t)$

end for

if no fingerprint **then**

  $w_{total} = w_{default}$

else

  $w_{total} = w_{default} + (1 - w_{default}) * \sqrt[|D|]{w_{hit}} \cdot w_{extra} \cdot w_{miss} \cdot \left(\frac{|Hit|}{|Hit|+|Extra|+|Miss|} \right)$

end if

return w_{total}

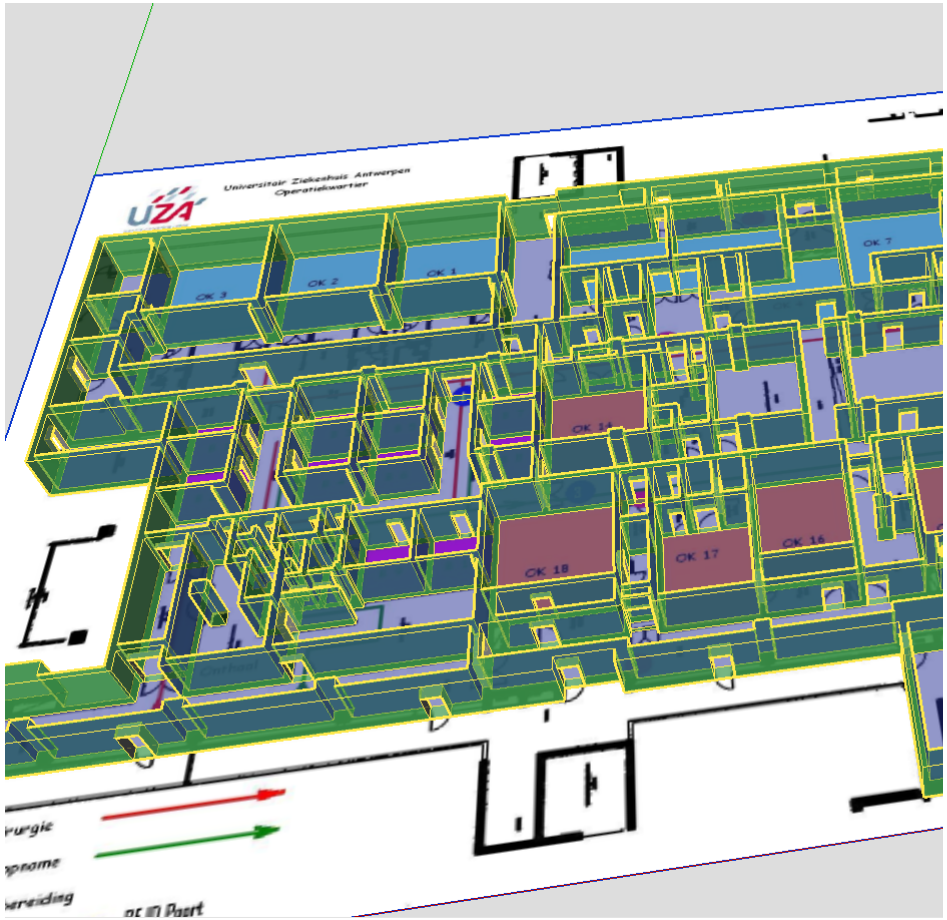
with:

$$p_{hit}(\mathbf{z}_t^d | \mathbf{x}_t) = p\left(D_t^i | D_{l_{\mathbf{x}_t}}^{+i}\right) = e^{-\frac{\left(D_t^i - D_{l_{\mathbf{x}_t}}^{+i}\right)^2}{2.\sigma_d^2}}, \text{ where } \sigma_d = 6.32 \text{ dBm}$$

$$p_{extra}(\mathbf{z}_t^e | \mathbf{x}_t) = e^{-\frac{(penalty_{extra})^2}{2.\sigma^2}}, \text{ where } \sigma = 4.47 \text{ dBm}$$

$$p_{miss}(\mathbf{z}_t^m | \mathbf{x}_t) = e^{-\frac{(penalty_{miss})^2}{2.\sigma^2}}, \text{ where } \sigma = 4.47 \text{ dBm}$$

Proof of Concept



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(71) Applicants *(for all designated States except US)*: **UNIVERSITEIT ANTWERPEN** [BE/BE]; Prinsstraat 13, B-2000 Antwerpen (BE). **ARTESIS HOGESCHOOL ANTWERPEN** [BE/BE]; Keizerstraat 15, B-2000 Antwerpen (BE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **WEYN, Maarten** [BE/BE]; Vincent Bavaisstraat 43, B-2540 Hove (BE).

(74) Agents: **WAUTERS, Davy** et al.; DenK iP bvba, Pastoor Ceulemansstraat 3, B-3191 Schiplaken (Hever) (BE).

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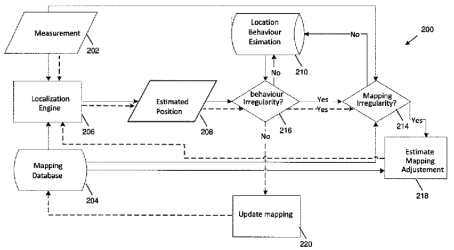

FIG. 2b

(57) **Abstract**: A method and device for dynamically altering the signal-space-to-physical-space mapping database of a set of access points for use in localizing of an object. The method comprises obtaining a location profile for the object and obtaining an estimated location of an object by measuring the signal parameter induced by at least one access point and using the signal-space-to-physical-space mapping database for deriving an estimated location from the measured signal parameter. The method also comprises determining whether the obtained estimated location complies with the obtained location profile for the object, and if the obtained estimated location does not comply with the location profile, dynamically adjusting the mapping database to obtain an adjusted signal-space-to-physical-space mapping database based on a difference between the measured signal parameter and the signal parameter corresponding with the signal space for the location expected based on the location profile.

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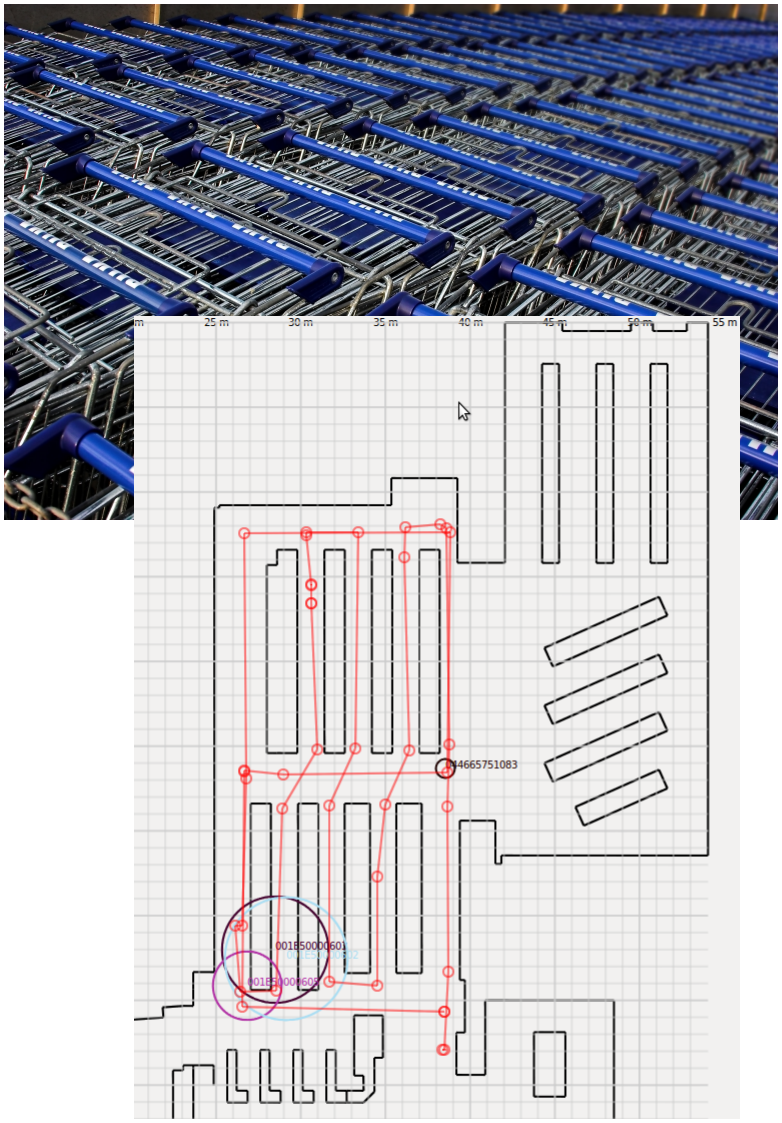
Market driven questions



Market driven questions

- One technology to rule them all?
- Multi-modality to rule them all!

End user driven questions

End User Driven Research

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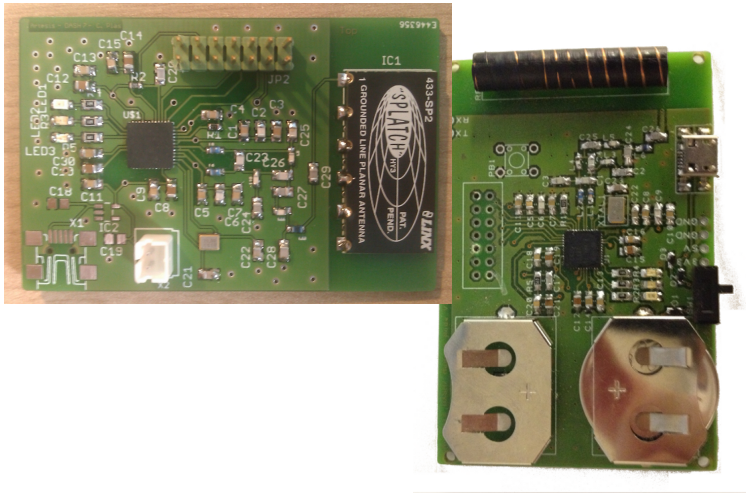

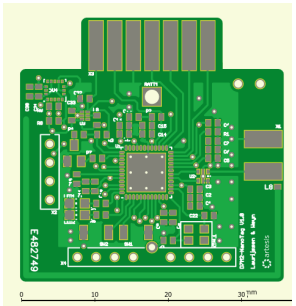

Theory conjointly with Practice

Location information will become as indispensable as time information!

Maarten Weyn
maarten.weyn@artesis.be