POSTERS

Journée Objets Connectés de Santé

Jeudi 5 octobre 2017
IMT / Télécom ParisTech

Institut Mines-Télécom

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Application of WebRTC enhanced with the Web of Things for Healthcare services

Journée Objets Connectés de Santé – 5 octobre 2017 - Paris

IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom

UMR IRISA

Auteurs

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Research axises:

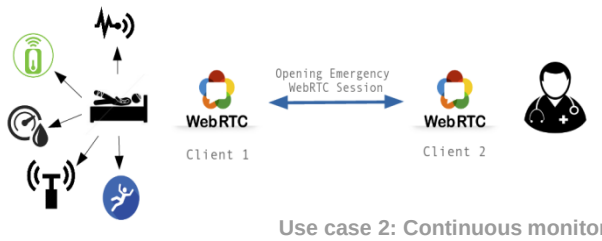
- Web of Things.
- WebRTC.
- Security.
- E-Health

Contributions:

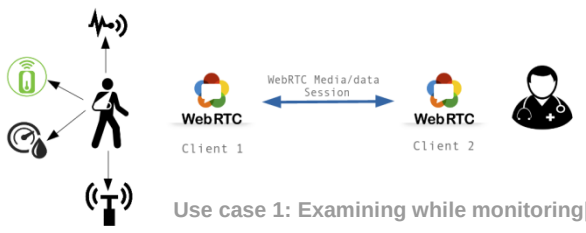
- Remote monitoring of the patients:
  - Multimedia communication.
  - Accessing smart medical devices
  - Exchanging health related data.
  - Real-time monitoring.
- Security:
  - Confidentiality.
  - Integrity.
  - Authentication.
  - Access Control

Interests:

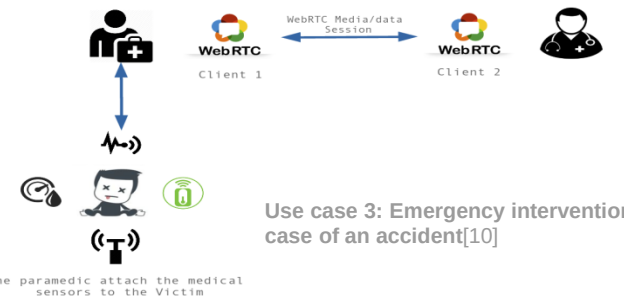
- Reduced cost.
- Less crowded hospitals.
- Better relations between the patient and the doctor.
- Lesser mobility for the patients.



Use case 2: Continuous monitoring[10]



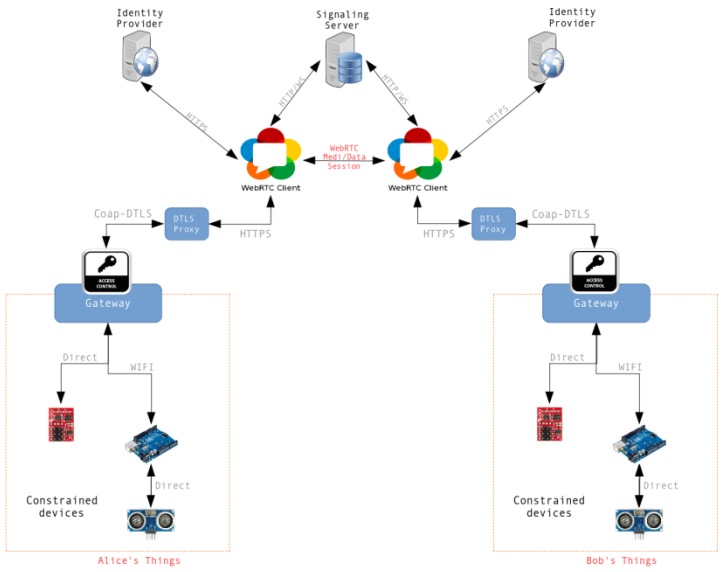
Use case 1: Examining while monitoring[10]



Use case 3: Emergency intervention in case of an accident[10]

Comparative analysis:

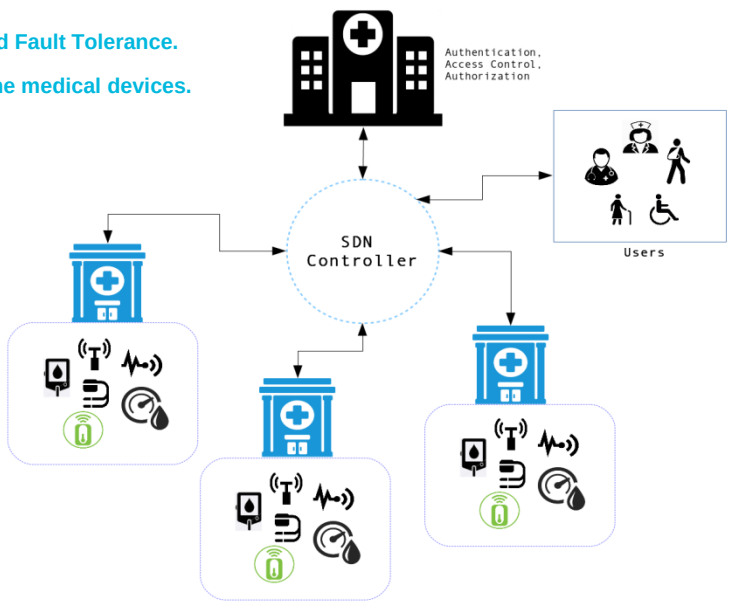
References	VoIP | WebRTC | Other	IoT / WoT	Security : Native | Additional | No	Access Control	Implementation
[1] F. Magrabi et al. "Home telecare: system architecture to support chronic disease management".	No	No	A	No	Yes
[2] C. Lau et al. "Synchronous web-based patient-centered home telemedicine system".	No	No	A	No	Yes
[3] H. Zheng et al. "Web-based monitoring system for home-based rehabilitation with stroke patients".	No	No	No	No	Yes
[4] M. A. Al-Taee et al. "Web-of-things inspired e-health platform for integrated diabetes care management".	No	WoT	No	No	Yes
[5] C. Y. Chiang et al. "An efficient component-based framework for intelligent home-care system design with video and physiological monitoring machineries".	V	No	No	No	Yes
[6] P. Pierleoni et al. "An innovative webrtc solution for e-health services".	W	No	N	No	Yes
[7] J. Jang-Jaccard et al. "Webrtc-based video conferencing service for telehealth".	W	No	N	No	Yes
[8] J. Azevedo et al. "An api proposal for integrating sensor data into web apps and webrtc".	W	IoT	N	No	No
[9] H. Moustafa et al. "Remote monitoring and medical devices control in ehealth".	W	IoT	N	No	Yes
Our propositions [10] [11]	W	WoT	A	Yes	Yes



Global view of our architecture [11]

Future Research:

- Exploring the area of WBAN, and the management of the security issues in such networks.
- Testing the feasibility of our solution in real-world situation.
- Exploring the possibility of using notion of the profile of the patient.
- Availability, Resilience and Fault Tolerance.
- The physical security of the medical devices.



Future research : Using SDN to manage the security of several medical facilities in the same time and in an efficient way

Contact : saad.eljaouhari@imt-atlantique.fr

[10] Saad El Jaouhari, Ahmed Bouabdallah, Jean-Marie Bonnin, and Tayeb Lemlouma. "Toward a smart health-care architecture using webrtc and wot".

[11] Saad El Jaouhari, hmed Bouabdallah, Jean-Marie Bonnin, and Tayeb Lemlouma. "Securing the communications in a wot/webrtc-based smart healthcare architecture".

Vers une démocratisation de l'analyse de données cinématiques corporelles via Kinect – un nouvel objet connecté?

Parties prenantes

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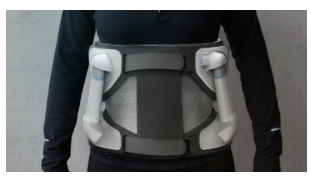
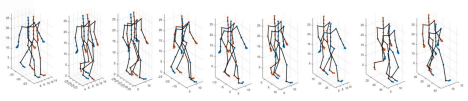
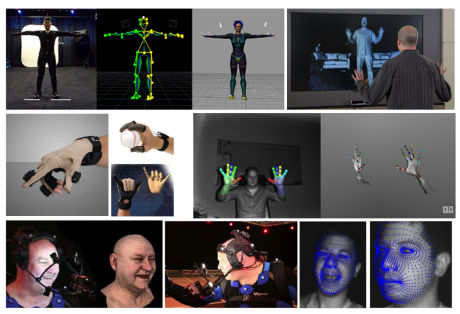
Analyse de performances physiques et applications (évaluation sportive et artistique, rééducation post-AVC, prévention aux chutes, etc.)



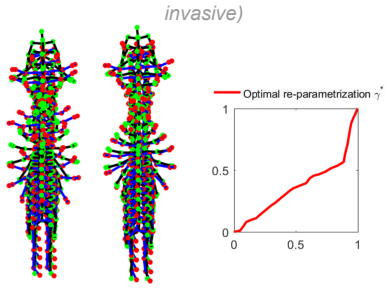
Evaluation clinique d'exosquelettes (Japet.eu)



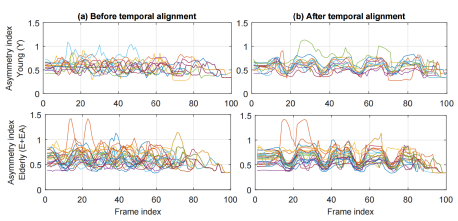
Problème de variabilité temporelle – comparer des séquences avec des vitesses d'exécution différentes



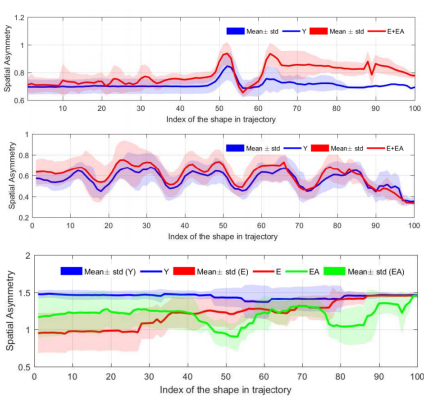
Acquisition de formes squelettiques 3D du corps humain (capteurs de profondeurs à faible coûts et non-invasive)



Alignement temporel de trajectoires



Symétrie spatiale dans le cas de 5-times-sit-to-stand avant et après alignement temporel des trajectoires



Moyennes et écart-types dans les cas (1) max. jump, (2) 5-times-sit-to-stand et (3) 1-leg balance

Approche classique de l'analyse cinématique corporelle

Paradigme basé sur le mouvement des articulations prises séparément!

- **Modélisation géométrique** *(forme)* – Un squelette 3D est un point sur un espace de formes (invariance à la rotation, translation et échelle),
- **Modélisation temporelle** *(trajectoire)* – L'évolution dans le temps est représentée par une trajectoire paramétrée sur l'espace des formes,
- **Métrique invariante** – Métrique tolérant les variabilités temporelles (c.-à-d. compare des trajectoires modulo des vitesses et des points de départs ≠)
- **Outils géométrique** *(sur les trajectoires)* – ré-échantillonnage, lissage, débruitage, interpolation de données manquantes, calcul de statistiques (moyennes, covariances, etc.)
- **Classification d'actions 3D** – illustration expérimentale sur des benchmarks internationaux de l'état de l'art (MSR Action 3D- MSR Pairs et Daily Activity).

***Boulbaba Ben Amor**, Jingyong Su, Anuj Srivastava: Action Recognition Using Rate-Invariant Analysis of Skeletal Shape Trajectories. **IEEE Trans. Pattern Anal. Mach. Intell**. 38(1): 1-13 (2016),*

Kinect…vers un objet connecté pour la santé et le bien-être?

Cadre géométrique pour l'analyse de cinématique

- **Caractéristiques spatio-temporelles pertinentes** – Symétrie spatiale (sS), symétrie temporelle (tS), vélocité relative (Vl) et équilibre (Bl),
  - **Symétrie spatiale (sS)**, quantifie à chaque instant la symétrie spatiale du corps et retourne une évolution de celle-ci dans le temps,
  - **Symétrie temporelle (tS)**, mesure la différence entre une action et son inverse dans le temps (e.g. marche avant/arrière, s'assoir/debout,..),
  - **Vélocité relative (Vl)**, mesure la vélocité de la forme (comme un ensemble d'articulations) tout au long d'une trajectoire % à une trajectoire de contrôle,
  - **Equilibre (Bl)**, quantifie la différence forme à forme entre réalisations effectuées les yeux fermés et les yeux ouverts.

***Boulbaba Ben Amor**, Anuj Srivastava, Pavan Turaga, Grisha Coleman: **A Novel Geometric Framework for Human Body's Kinematic Data Analysis**. Submitted to IEEE Trans. Pattern Anal. Mach. Intell. (2017),*

Résultats obtenus sur une base validée cliniquement

Analyse statistiques des fonctions (sS, tS, Vl, Bl)

- Base **K3Da** contient une batterie de tests de performances physiques de groupes de différents âge, historique athlétique, genre, poids et taille,
- **Analyse en Composante Principale (ACP)** sur les fonctions obtenue,
- ***t*-test statistiques** (*Welsh's t-test et Hotelling's T-square test*) dans le nouvel espace issu de l'ACP,
- Principales découvertes (*p-value* < 0,05) liés à la base de données,
  - L'âge affecte négativement la symétrie (donc la stabilité) du corps en mouvement,
  - L'historique sportif permet aux personnes âgées de maintenir une stabilité comparable à celle des plus jeunes,
  - La vision joue un rôle vital dans le maintient de la stabilité chez les personnes âgées,
  - Le saut maximum révèle un impact négatif de l'obésité sur la symétrie,
  - L'âge impacte négativement la capacité de réaliser une action et son inverse de manière similaire,
  - L'âge impacte négativement la vélocité de réalisation des actions.

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Sponsorisé par : Fulbright Commission Franco-Américaine

Octobre 2017 Journée Objets Connectés pour la Santé Paris.

LARGE SCALE CONNECTIVITY

INTERFERENCE AND RELIABILITY IN HETEROGENEOUS WIRELESS NETWORKS

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THE ABSTRACT

The huge number of massive type devices that will be deployed in the coming years creates an environment where interference strongly degrades the communications. Low cost devices do not allow complex signal processing or numerous signaling exchanges. However, a proper knowledge about the interference statistics makes connectivity significantly more reliable.

THE CHALLENGE

How can we improve the connectivity robustness with unpredictable interference and communicating devices that have very limited resources?

And more precisely, we wonder what will interference look like, how we can model it and improve the transmission quality?

THE SOLUTION

Increasing network densities introduce new challenges in wireless communication. Especially in the ISM bands, interference will strongly limit the network capabilities. Suppressing it however could be unrealistic in practice, especially for low cost devices but also if several networks are simultaneously active in ISM bands. Consequently, there is a need to design receivers that are robust in interference limited situations. One challenge is that in such context, interference is not necessarily Gaussian but may present an impulsive behavior. Besides, one single object can be confronted to several different environment.

Theoretical analysis

Interference

Interference is the sum of many random signals that come from different users, in our network or in other networks sharing the same band:

$$y_i(t) = \sum_{i=1}^{N} R_i^{-\frac{\gamma}{2}} A_i x_i(t)$$

It has been shown in many previous papers, that a simple Gaussian assumption does not match the interference specificity and distributions able to capture rare events (large values with low probability in our case) are necessary (see Fig. 1).

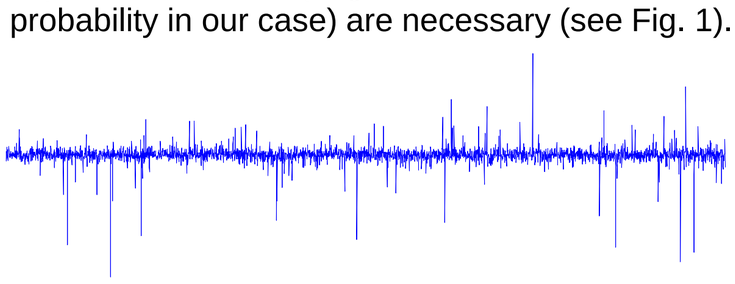

Fig.1: Impulsive interference.

Receiver design

The first consequence is that different from the one that any receiver makes today, assuming a Gaussian noise. Let's assume we receive two samples (r_1, r_1) carrying the same information $x \in \{-1,1\}$. The optimal (in the likelihood sense) decision is based on the log-likelihood ratio Λ:

$$\Lambda = \sum_{i=1}^{N} log \frac{(f_{I+N}(r_i-1)|x=1)}{(f_{I+N}(r_i+1)|x=-1)} \quad \begin{matrix} > 1, \hat{x} = +1 \\ < 1, \hat{x} = -1 \end{matrix}$$

The function $f_{I+N}(,)$ is the probability density function of the noise plus interference; we assume a perfect knowledge of the channel state information.

The Gaussian assumption reduces to a linear boundary in the 2D plane (r_1, r_2) but a non Gaussian interference strongly modifies the decision region as shown on Fig. 2.

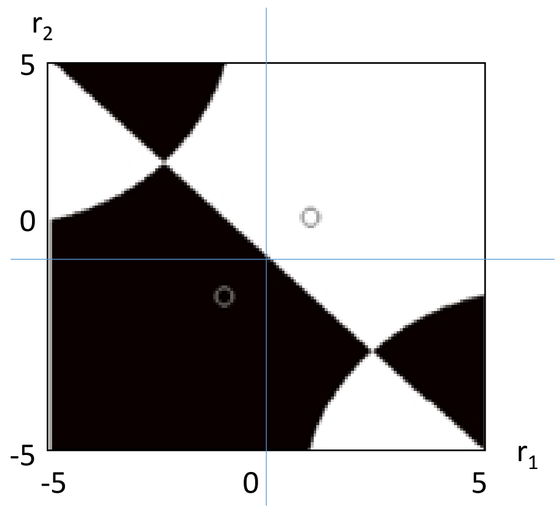

Fig 2: Decision region with an impulsive interference. The two possibly transmitted symbols are given by the circles (-1 in the black area and +1 in the white one). Λ>1

Several ways to optimize the receiver have been proposed. We show in Fig.3 the perfomance of several solution. The optimal depends on the perfect knowledge of the noise plus interference distribution, which can be difficult in practice.

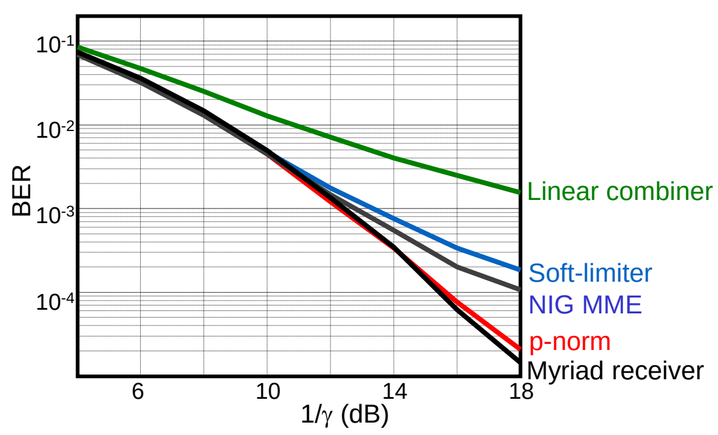

*Fig.3: Receiver performance in a mixture of Gaussian and α-stable noise (*NIR=0dB, α=1.5*).*

Practical issues

The link between theory and practice remains diificult. The main issue is the scale of the studied network. Creating such an interfering environmant with the capabilities of recording and analyzing the data is a difficult task.

In a laboratory.

It is possible with USRP to analyze a whole frequency band and the effect of interference issued from different networks; We show for example in Fig.4 a measurement that shows a ZigBee retransmission caused by a Bluetooth pulse along with WIFI packets,

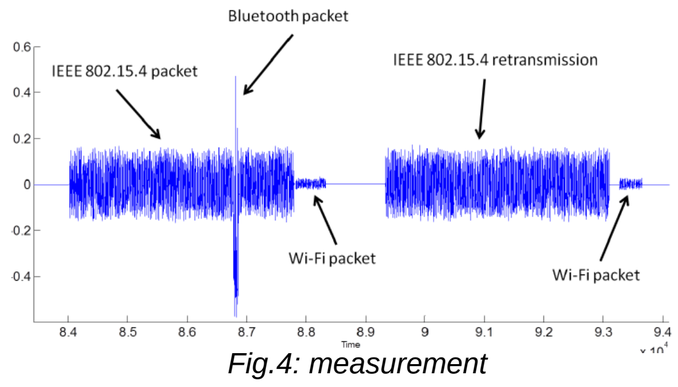

Fig.4: measurement

Large scale deployment

The last but essential point is to test the connectivity robustness in real large scale scenarios. This can only be done in real situation. The key of the reliability will be the gateways (see Fig. 5) that will get the data from the things towards the cloud. They need software radio and calculation capabilities and USRP are an excellent candidate for these boxes.

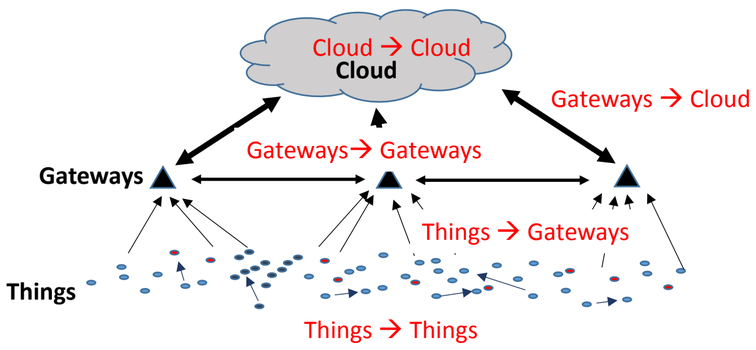

Fig.5: Architecture, USRP as multistandard gateways

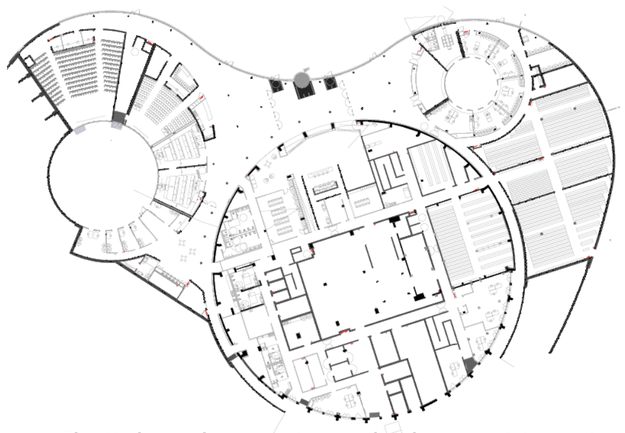

Fig.6: learning center – deployment target

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iemn Institut d'Electronique, de Microélectronique et de Nanotechnologie UMR CNRS 8520

Apprentissage et segmentation pour le suivi de comportements à domicile

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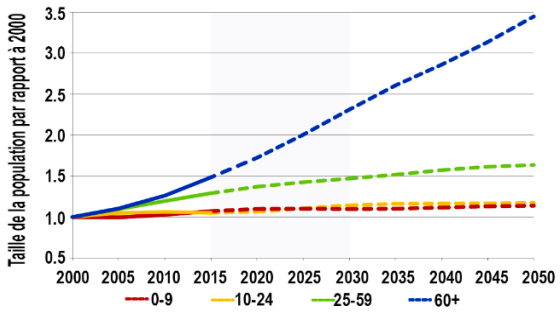
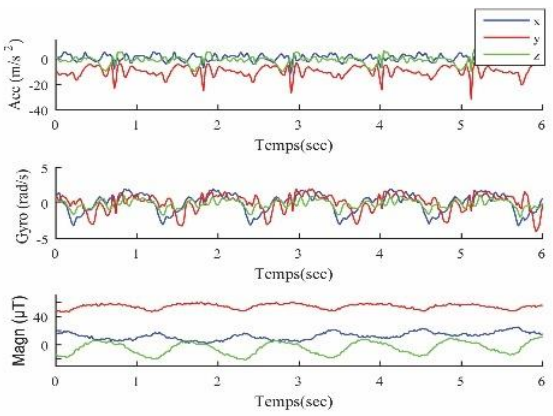


Population mondiale selon le groupe d'âge.



Signaux inertiels d'une personne qui marche.

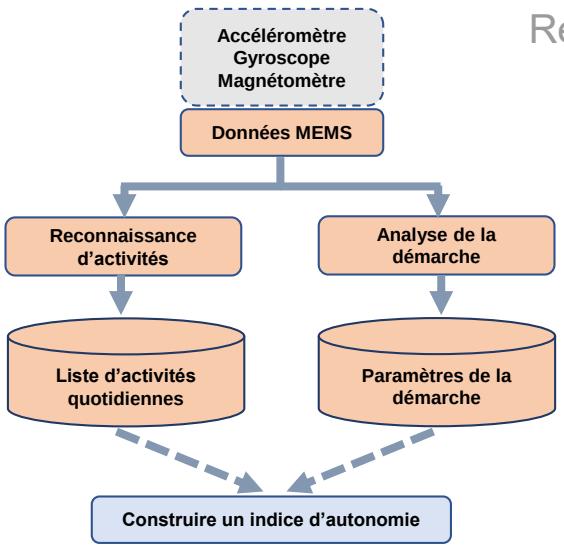
Introduction

- **Travaux de thèse** – Construire des indicateurs de qualité de vie caractérisant l'évolution de l'état de santé et les éventuelles dégradations.
- **Objectif** – Réduire ou retarder la perte d'autonomie chez les personnes âgées.
- **Perte d'autonomie** – L'incapacité pour une personne d'effectuer certains actes de la vie quotidienne.
- **Causes de la perte d'autonomie** – Maladies chroniques, limitations fonctionnelles, restrictions d'activités.

Microsystèmes électromécaniques (MEMS)

- **Accéléromètre** – Accélérations statiques et dynamiques.
- **Gyroscope** – Vitesse angulaire.
- **Magnétomètre** – Force du champ magnétique local.
- **Avantages** – Peu coûteux, consomme peu d'énergie, moins intrusif comparé aux caméras.
- **Dispositifs utilisés** – Smartphone, montre connectée.

Notre approche

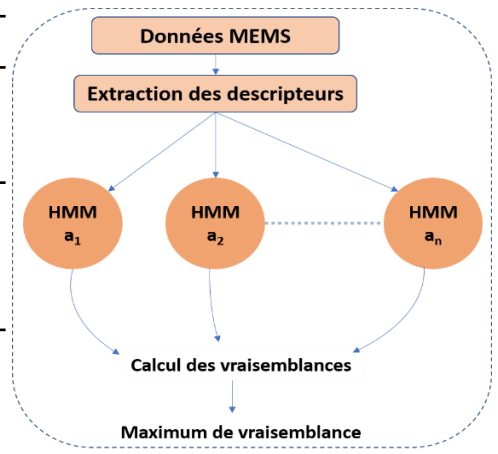


Approche proposée pour calculer l'indice d'autonomie.

Reconnaissance d'activités

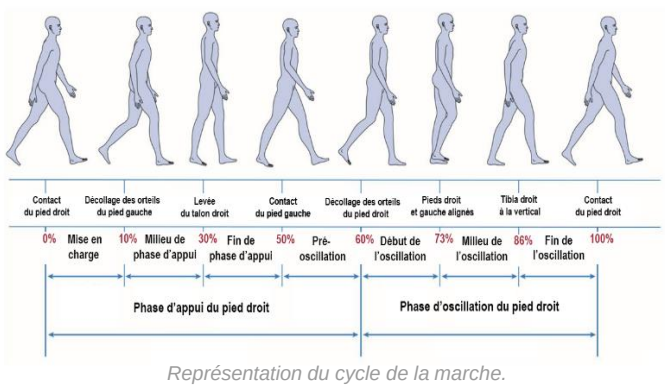
Nature	Activités
Posture	Debout Assise Allongée
Activité périodique	Marcher Jogging Monter les escaliers Descendre les escaliers
Transition de postures	Assise-Debout Debout-Assise Assise-Allongée Allongée-Assise

Activités prises en compte dans notre système.



Classification d'activités.

Analyse de la démarche



Représentation du cycle de la marche.

Transformations de signaux

-Transformée de Fourier
-Transformée en ondelettes
-Autocorrélation
-Décomposition Modale Empirique

Extraire les paramètres de la marche

-La vitesse de la marche
-Le degré d'équilibre
-L'instabilité de la marche
-La variabilité de la marche

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Le 5 octobre 2017 – Journée Objets connectés en Santé de l'IMT - Telecom Paristech.

MONITORING IN REAL TIME OF THE BLOOD PRODUCTS SUPPLY CHAIN BASED ON THE PHYSICAL INTERNET PRINCIPLES

Quentin Schoen, Matthieu Lauras, Sébastien Truptil, Franck Fontanili, Anne Ghislaine Anquetil

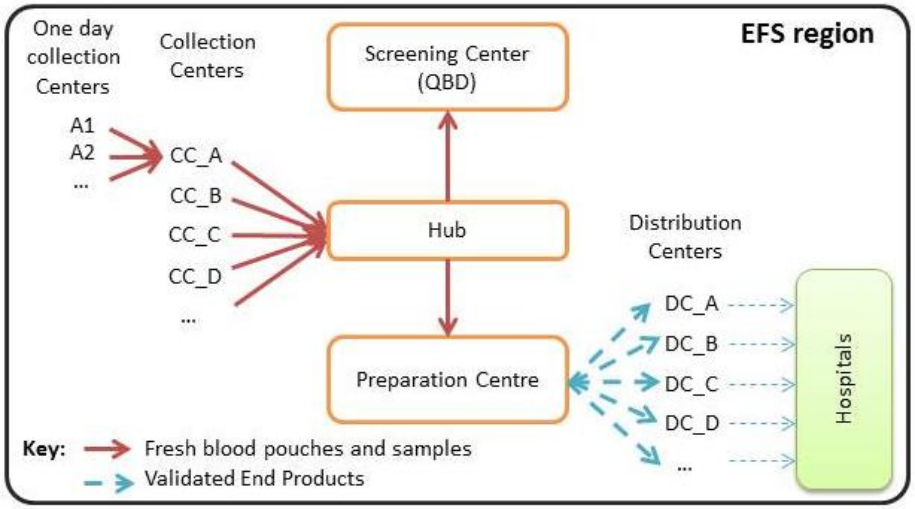
Context: The blood products transportation

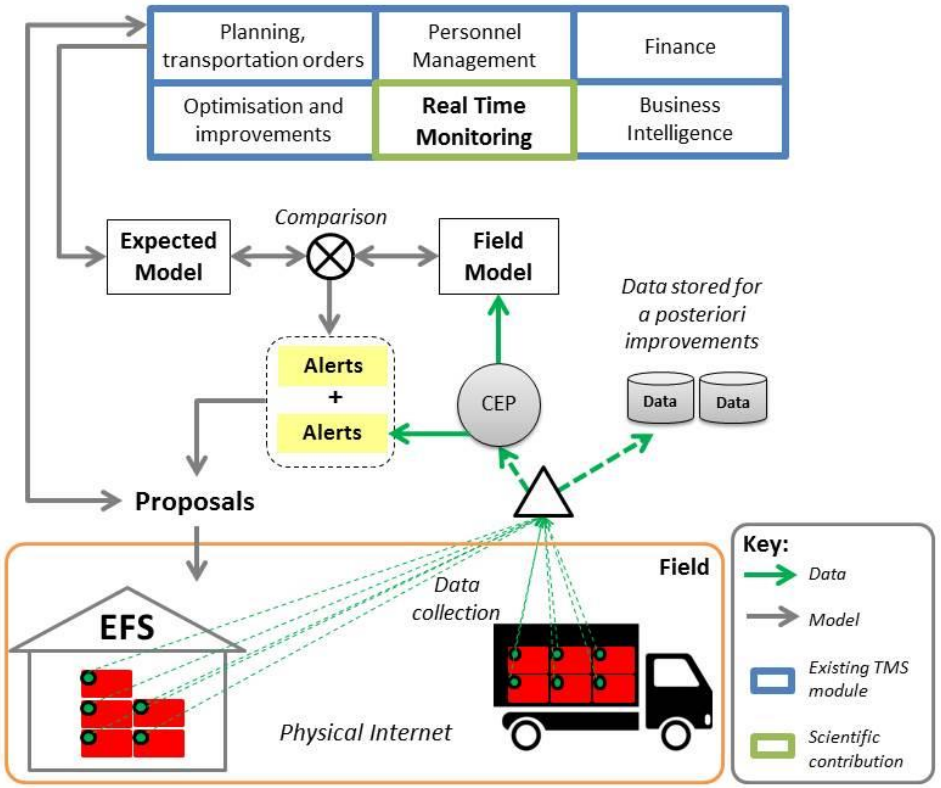
Everyday, several thousands of blood products containers are transported everywhere in France by trucks, plains, trains. The temperature, depending on the product varies between -25°C and 22°C.

Technical issues:

Current system: The traceability of the containers is insured with paper documents non homogeneous in each region. A lack of information exists in the monitoring in real time.

Problematic : How do we insure the monitoring in real time of the sensitive blood products containers in order to react to unexpected events efficiently with agility ?





Road map and perspectives

- Building of **a real time monitoring module** to track and trace the containers during the transportation processes, based on the Physical Internet principles.

- The main objective is to combine each container state, the needs of each French Blood Establishment (EFS) site and the unexpected events detected (traffic jam, urgent demand, temperature problem, etc.) to improve **the agility and efficiency.**

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École Mines-Télécom

JESS 10/2017

Institut Mines-Télécom

Subject:

A Tool-based approach to Visualize, Analyze, Diagnose, and Enhance the patient's pathways.

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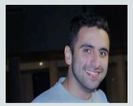
MEDIA-TECH
Embarquez pour l'innovation

Sina Namaki Araghi (Ph.D Fellow)



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Abstract

Purpose: This research work aims at proposing an approach towards modeling, analyzing, and diagnosing the execution of operational processes in healthcare.

Findings: The need for hospitals to learn how their processes operate in reality derives them to apply business process management and process mining techniques. One of the main actors in the processes are the patients. This approach aims at extracting knowledge for hospital directors by monitoring and scanning patient's pathways.

Value: The contributions of this work are based on highlighting different benefits of using Real Time Location Systems, Process Mining, BPM, SQC in the context of healthcare and especially smart hospitals. Additionally, new approaches on analyzing and diagnosing patients pathways as business processes will be delivered.

Methodology: The research team behind this work invites experts to have a glance on the approach of this work which has been presented in this poster by figure 1 and 2.
In figure 3 an example illustrates the possible out comes of the approach.

Key words: Business Process Management, Process Mining, Real Time Location Systems, Statistical Quality Control.

The Example ***(cf: Figure 3):*** As it has been shown in figure 3, in healthcare from the moment patient arrives in the building until it goes out of facility there are several events and activities that are invisible from expert's eyes, such as *length of stay*, *distance of pathways*, and etc. This approach of analyzing patient's pathways could provide for healthcare business process analysts a great knowledge about the time that patient has spent in different sectors of hospital. Additionally, one could gain a knowledge on efficiency of execution of the operational processes.

Figure 1: An overall view on the mindset of thesis

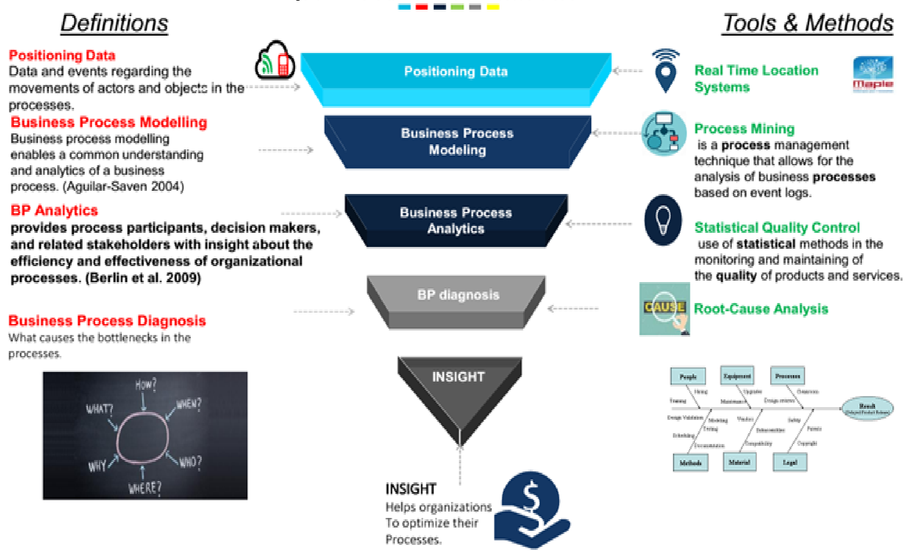


Figure 2: The Big Picture of project and different functionality in the service line of generating knowledge out of location data

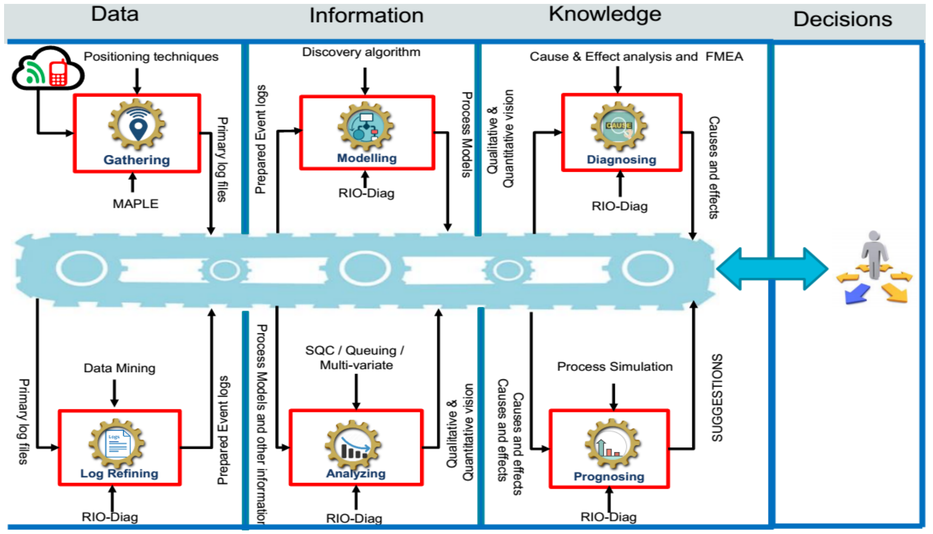
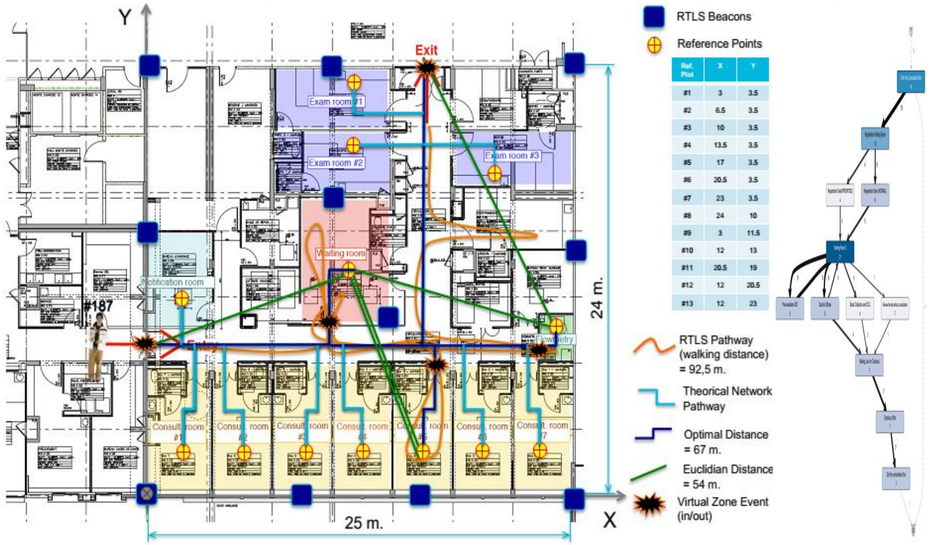
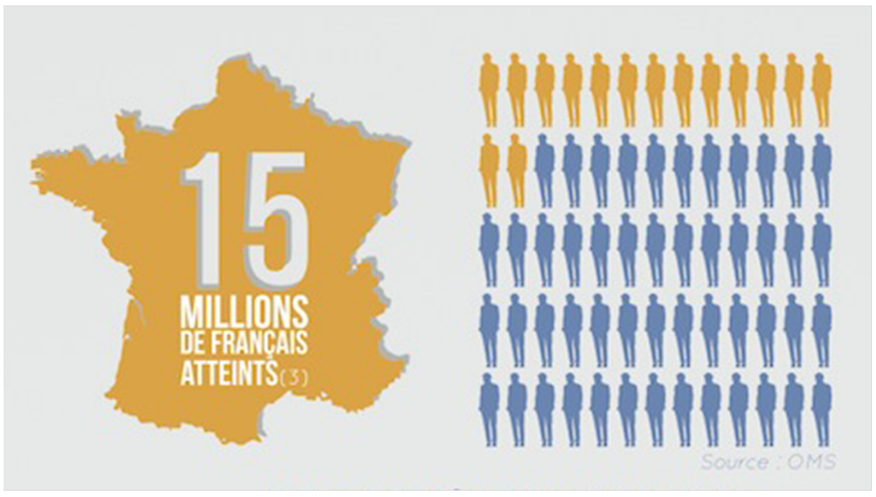


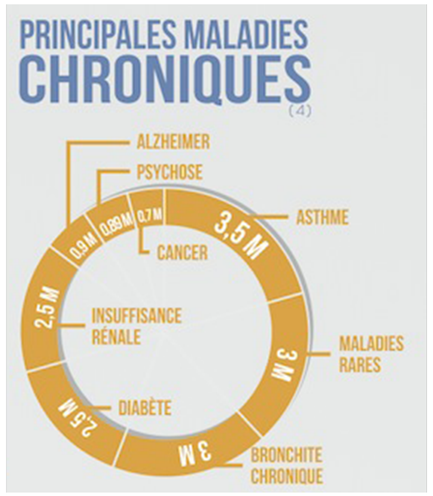
Figure 3: An example of transforming location data of patient into Business Process Models as a technique to provide more knowledge on the process.

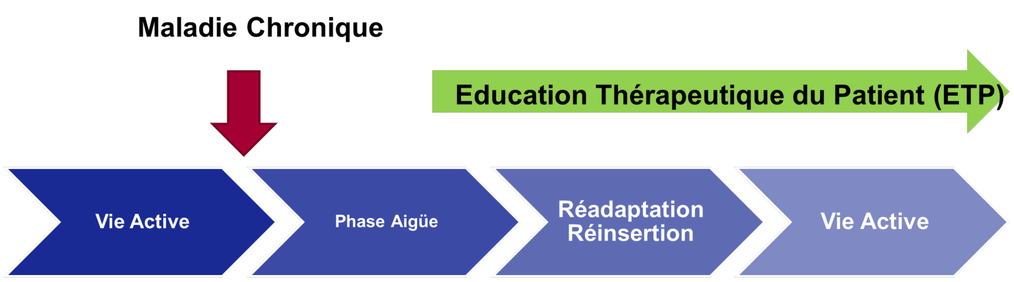


NET : Numérique et Education Thérapeutique

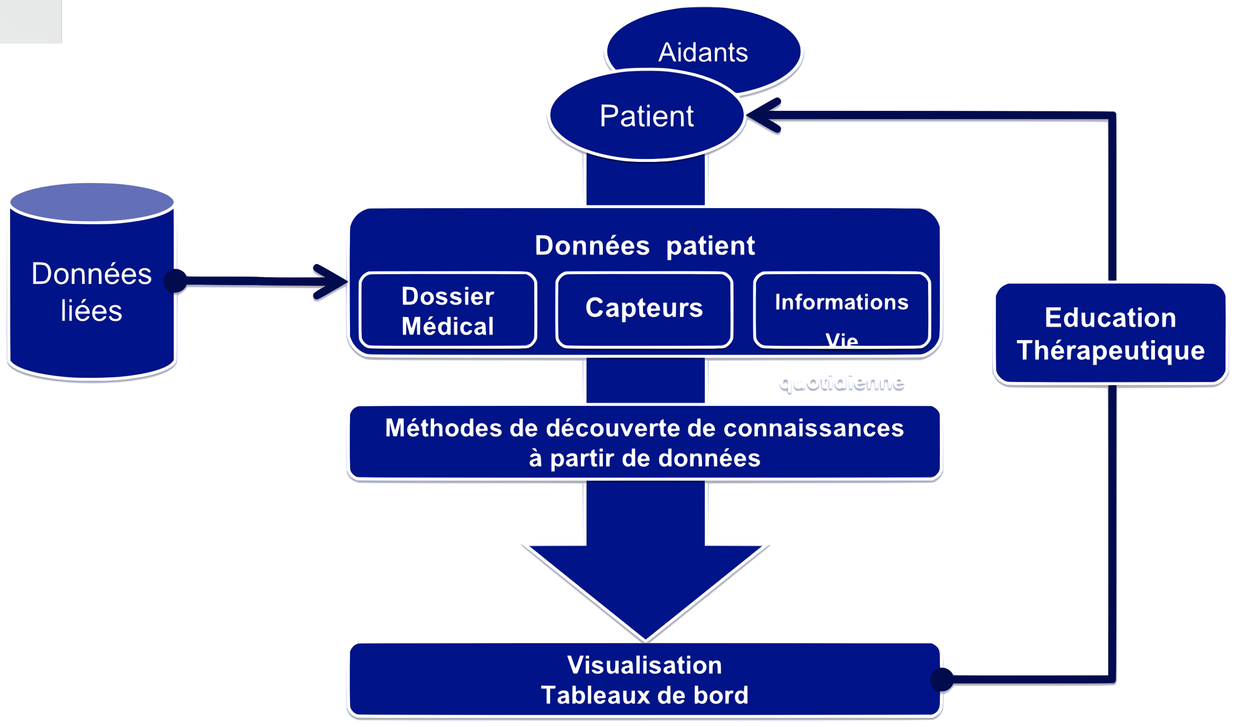
Etude et recherche pour le développement d'une boîte à outils numériques d'analyse visualisation de données pour l'éducation thérapeutique de patients atteints de maladies chroniques







L'éducation thérapeutique du patient vise à aider les patients à gérer au mieux leur vie avec une maladie chronique. Elle est un processus continu, qui fait partie intégrante et de façon permanente de la prise en charge du patient.



Découverte de connaissances à partir de données patient

Diabète type 1

382 MILLIONS
DE PERSONNES ATTEINTES DANS LE MONDE [1]

56 MILLIONS
DE PERSONNES ATTEINTES EN EUROPE [1]

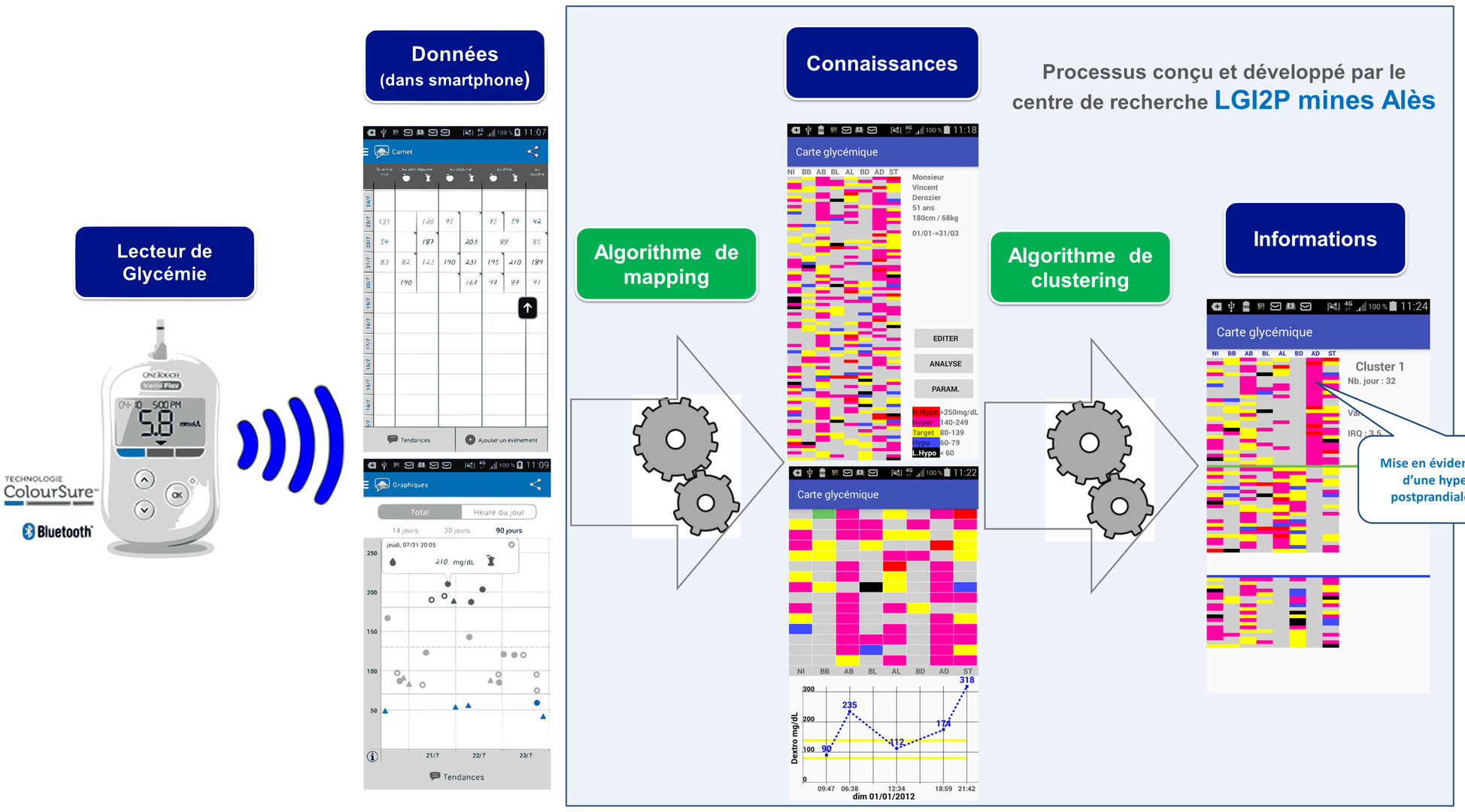
+ DE 3,7 MILLIONS
DE PERSONNES ATTEINTES EN FRANCE [2]

400 NOUVEAUX CAS DIAGNOSTIQUÉS CHAQUE JOUR EN FRANCE [3]

36%
DES EUROPÉENS
SONT ATTEINTS DE DIABÈTE SANS LE SAVOIR [1]

ENTRE 600 000 ET 700 000
PERSONNES SERAIENT DIABÉTIQUES SANS LE SAVOIR EN FRANCE [3]

Sources:
-Plan 2007-2011 pour l'amélioration de la qualité de vie des personnes atteintes de maladies chroniques, sante.gouv.fr
-Recommandation de la has 18 mai 2006, has.sante.fr
-The international diabetes federation 2013
-Fournier C. et al., rapport ENTRED
-Entred study 2007



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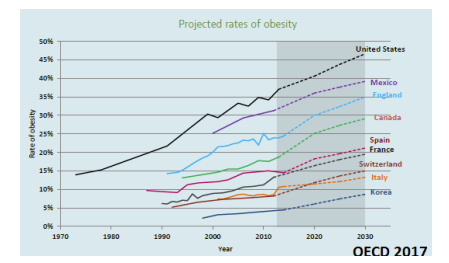
MINES Alès

Recherche en e-santé au service de la Mobilité

Des partenaires académique smultidisciplinaires
J Cissoko. M Duclos. P Lacomme. L Paris. R Phan. S Rousset

CONTEXTE

Développement des maladies chroniques – obésité, diabète, maladies cardiovasculaires – liées à l'évolution des modes de vie et à l'environnement. Les populations de plus en plus inactives et sédentaires ne suivent pas les recommandations en activité physique. Le manque d'outil scientifiquement valide et peu onéreux pour évaluer précisément l'intensité de l'activité physique justifie nos recherches.



AXES DE RECHERCHE

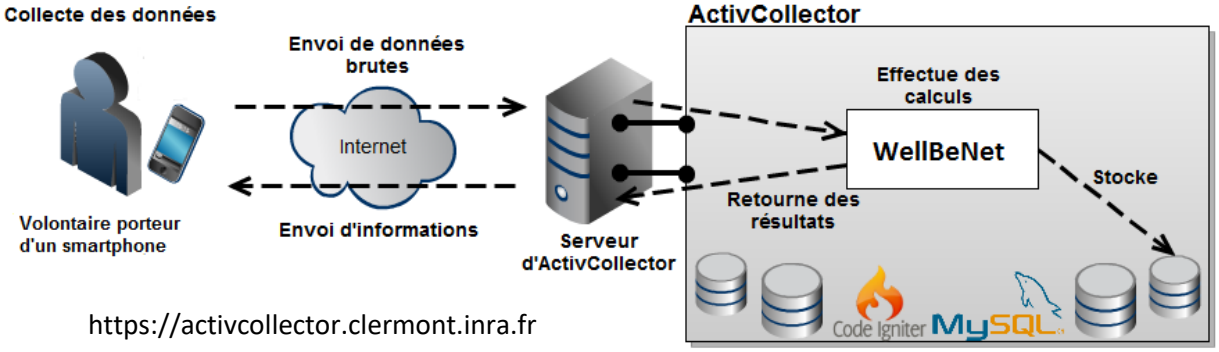
Comprendre les relations entre les comportements et l'état de santé en conditions réelles de vie

Evaluer
- les activités physiques de faible intensité et la sédentarité
- les choix alimentaires et les scores nutritionnels associés
- les déterminants émotionnels et contextuels des comportements

Développer des applications avec de nouveaux algorithmes issus de la recherche, validés et publiés

CREATION D'OUTILS MOBILES POUR L'EVALUATION COMPORTEMENTALE EN CONDITIONS REELLES

- Le serveur : ActivCollector



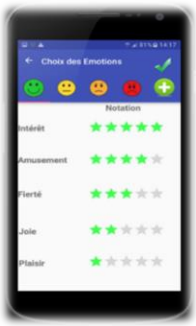
https://activcollector.clermont.inra.fr

- La suite d'applications mobiles WellBeNet

eMouveRecherche

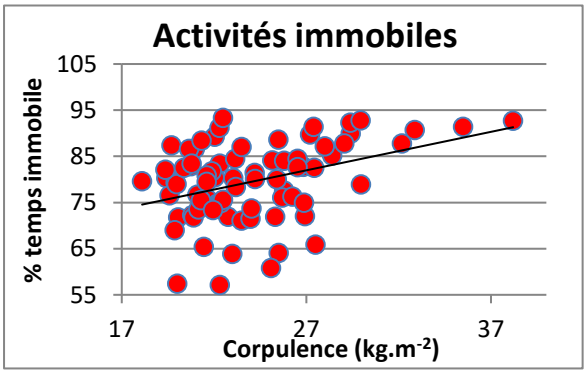
Intellilife Pro

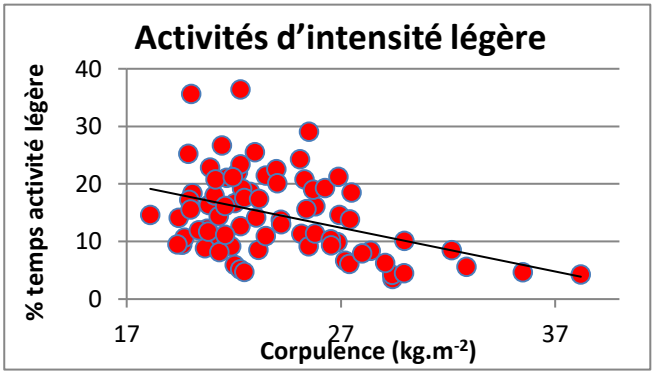
NutriQuantic



EmoSens

RESULTATS PRELIMINAIRES : Relation entre Activités Physiques Spontanées et Corpulence





CONCLUSION : Les activités d'intensité légère, trop rarement mesurées, jouent un rôle essentiel en santé

Outcomes of consumer IoT device appropriation: a study of consumers' daily effective uses of smart watches

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Research objective

❖More than 21 billions of inter-connected smart objects will form an Internet of Things by 2020.(Gartner, 2015)

❖Phenomenon: 30% end users' disengagement with smart connected objects after 6 months (GFK, 2015)

❖Little is known about the effective uses of these objects as appropriated by consumers

❖The present study investigates consumers' effective uses of IoT device in daily life, with an empirical study on appropriation of smart watches that have been widely perceived as the "next big thing" popular in the upcoming era of Internet of Things (Cecchinato, Cox & Bird, 2015)

State of the art development

❖ **Appropriation** : how people use, adapt and fit the technology in the daily practices, work or leisure (Carroll et al., 2003; Dourish, 2003; Waycott, 2005; Karim, Mohamed, & Hussein, 2011; Bar, Pisani & Weber, 2016).
* In this regard, **appropriation refers to the effective use of a technology in a way that helps attain end users' goals for using this technology beyond designers' initial purposes.**

❖**During the process of appropriation:**
○ Technology will be transformed from the initial version of designers to "Technology in use"(Carroll et al., 2003).
○ Users participate actively and subjectively in the shaping of technology by giving meaning to it and integrating it into their daily activities and social relationships (Mackay& Gillespie, 1992; Williams & Edge, 1996; Ling, 2004).
→ Therefore, **appropriation is also a users' continuous negotiation on how to use the technology in their real life.**

❖ Much previous work has focused on process of appropriation at a group or organizational level (Orlikowski 1992; DeSanctis and Poole 1994). Studies on nature of technology appropriation at an individual level have been surprisingly lacking.

Typology of user-product interaction

Interactions	Definition	Reference
Physical Interactions	Physical interactions refer to what users do with a product, namely users' manipulation of the product)	(MORSHEDZADEH, & WATANABE , 2016
Cognitive Interactions	Cognitive interactions focus on the product at hand. These interactions can result in knowledge for users who need helps to comprehensively understand how to better use a product	(Forlizzi, & Battarbee, K. 2004 ; MORSHEDZADEH, & WATANABE , 2016))
Functional interactions	Functional interactions signify what users carry out as tasks with the purpose of doing something with a product	(MORSHEDZADEH, & WATANABE , 2016)
Expressive interactions	Expressive interactions allow users to form a relationship with a product. In these interactions, users may modify, personalize and invest effort to create a better fit between product and them	(Forlizzi & Battarbee, 2004) (DeLanda 2006, p12) (Morshedzadeh et al.,2016).

Results

1- End users' personal choice of their interactions with smart watch result in their effective uses in the daily life

Interaction types	Explanation
Manipulation interactions	product handling and manipulations without purpose, rather than to observe what is going on with the smart watch
Sensorial interactions	manipulations without purpose related to sensorial stimulations and feelings on smart watch
Functional interactions	interactions allow users to carry out as tasks with the purpose of doing something with the smart watch.
Cognitive interactions	interactions aim to comprehensively understand how to better use the smart watch and applications embedded.
Expressive interactions	interactions allow users to form a special relationship with the smart watch. User may change, or customize, investing personal effort in creating a better fit between smart watch and him.

2- People's effective uses accomplish their different goals in the daily life

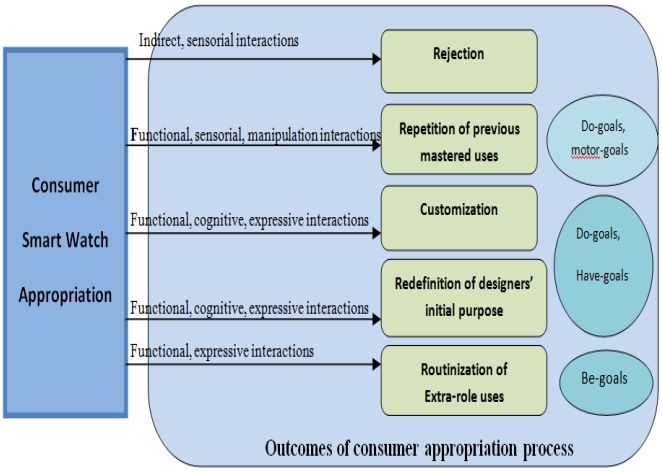
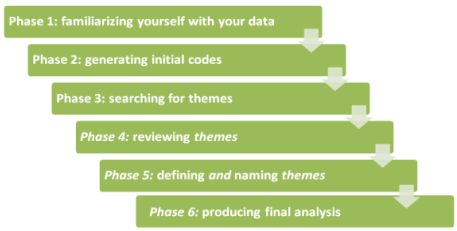


Figure 1: Outcomes of consumer smart watch appropriation process

Methods

18 semi-structured interviews
Followed the thematic content analysis steps suggested by (Braun & Clarke, 2006):



* Each of the three authors joined in developing themes, and contributed by critically examining preliminary analysis of the two others.
* higher than 80% agreement among 3 authors on final analysis

Interaction types	Modes of effective uses	Explanation	Accomplished Goals
(Indirect) sensorial interaction	**Rejection**	Interaction occurs without a direct contact with the watch, or when people interact with the product for other uses.	
Functional interaction Sensorial interaction Manipulation interaction	**Repetition of previous mastered uses**	The user transfers his knowledge and competence on existing mobile devices to the smart watch. Interactions that result in this effective use are the most automatic and well-learned ones. They do not complete for users' attention, instead, these interactions allow users to focus on the consequences of their daily activities	Do-goals Motors -goals
Functional interaction Cognitive interaction Expressive interaction	**Customization**	This effective use concerns the personalization that designers allow users to make.	Do-goals Have-goals
Functional interaction Cognitive interaction Expressive interaction	**Redefinition of designers' initial purpose**	This effective use refers to the restructure of the smart watch's elements by users to create something new. It concerns some uses that are not originally foreseen by designers.	Do-goals Have-goals
Functional interaction Expressive interaction	**Routinization of Extra-role uses**	This effective uses signifies that the practices around the extra-role uses of product become routine or stable. Extra-role uses can concern discretionary uses in the daily life by spending extra time, investing extra effort beyond what is expected, during users' discretionary time, in order to contribute more to the smart watch.	Be-goals

Conclusion

we explore the effective uses as the outcomes of consumer IoT device appropriation process, which are meaningful for researchers and practitioners in marketing and design.

we show the impact of interactions on effective uses of IoT device , and qualify different types of interactions between end user and IoT device (smart watch)

we find that 5 modes of effective uses in the form of rejection, repetition of previous mastered uses, customization, redefinition of designers' initial purpose and routinization of extra-role uses accomplish users' four level hierarchy goals of motoring, doing, having and being in the daily lives

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Medical and wellbeing things as cloud ressources

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Auteurs

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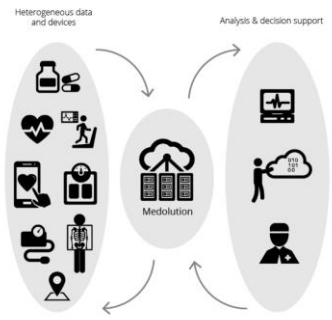
Partenaires



Context: an European challenging research topic

MEDOLUTION – MEDical care evOLUTION

- **Secure, reliable & accessible system** for continuous monitoring of chronical patients with long-term and real-time decision support
- **Cubic complexity** for connecting millions of sensors to millions of medical applications for millions of patients
- **Big medical data gathering, analyzing and visualizing** to provide professional caregivers with valuable information, in an intuitive manner with real-time

Current limitation: *the mutual vendor-client lock-in*

Specific client demands coupled to personalized solutions

- **Specific client needs,** shaped according to particular, use-case oriented specifications
- **Personalized solutions, often developed through property APIs** allowing very few (if any) code reusability
- **Too many open standard efforts,** with very little convergence and industrial involvement

Vision: open integration ecosystem for medical things

Creating the software tools allowing *plug & play* IoT

- **Easy to install,** thanks to common web technology usage
- **Easy to manage,** thanks to two-directional virtualization approach
- **Cross-standard,** thanks to a two-ways approach to current day standardization actions

Current achievement: PoC for our methodological approach

Virtualizing applications and their connected devices

- **Medical authentication devices,** like medical card reader (*lecteur de carte vitale*)
- **Proprietary data format devices,** with undisclosed communication protocols

Proprietary data format

Medolution Device Connector

Medolution

- semantic data
- xml/json packing

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Evaluation de la qualité des données basée sur la métrique Discrimination Rate

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Telecom SudParis, Orange Labs

RESUME

La qualité des données est difficile à évaluer car elle dépend du besoin de celui qui les utilise. Nous proposons une approche simple et innovante permettant d'exprimer ce besoin et de le mesurer avec précision. Notre méthode est basée sur la métrique «Discrimination Rate » qui mesure la capacité d'identification d'un attribut.

OBJECTIF

Evaluer de façon précise la qualité des données dans une base de données en tenant compte d'un besoin exprimé.

METHODE

La méthode se décline en 2 opérations:

1. **Expression d'un besoin d'utilité à partir des attributs d'intérêt et des partitions d'intérêts**
2. **Evaluation du besoin en se basant sur la métrique Discrimination Rate**

Expression du besoin

Considérons une étude qui vise à administrer des traitement en se basant sur l'age et le lieu de résidence des sujets.

Table Originale (1)

	ZIP Code	Age	Disease
1	35510	22	cancer
2	35602	35	diabetes
3	35712	63	malaria
4	35510	22	cancer
5	35510	22	cancer
6	35602	35	malaria
7	35715	45	malaria
8	35602	32	diabetes
9	35703	40	diabetes

Table Partitionnée en foction du besoin (2)

	ZIP Code	Age*	Disease
1	355**	2*	cancer
2	355**	2*	cancer
3	355**	2*	cancer
4	356**	$\geq$ 40	malaria
5	356**	$\geq$ 40	diabetes
6	356**	$\geq$ 40	malaria
7	357**	3*	malaria
8	357**	3*	diabetes
9	357**	3*	diabetes

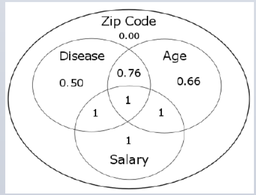
Evaluation du besoin avec le DR

L'évaluation est basée sur la métrique Discrimination Rate qui mesure la capacité d'un attribut à identifier un sujet. Les valeurs varient entre 0 et 1.

$$DR_X(Y_1, Y_2, ..., Y_n) = 1 - \frac{H(X|Y_1, Y_2, ..., Y_n)}{H(X)}$$

Table illustrative

Respondent	ZIP Code	Age	Salary	Disease
resp 1	35510	22	4K	cancer
resp 2	35510	35	5K	diabetes
resp 3	35510	63	3K	malaria
resp 4	35510	22	13K	cancer
resp 5	35510	22	8K	cancer
resp 6	35510	35	15K	malaria
resp 7	35510	45	9K	malaria
resp 8	35510	35	7K	diabetes
resp 9	35510	40	11K	diabetes



RESULTATS

Table des résultats (3)

X	Y	$DR_X(Y)$
Disease	22	1
Disease	32	1
Disease	35	0.85
Disease	40	1
Disease	45	1
Disease	63	1
Disease	Age	0.85
Disease	35510	1
Disease	35602	0.80
Disease	35703	1
Disease	35712	1
Disease	35715	1
Disease	ZIP Code	0.80
Disease	22/35510	1
Disease	32/35602	1
Disease	35/35602	0.85
Disease	40/35703	1
Disease	45/35715	1
Disease	63/35712	1
Disease	Age/ZIP Code	0.85
Disease	2*	1
Disease	$\geq$ 40	0.8
Disease	3*	0.8
Disease	Age*	0.6

Interpétation des résultats

Cette table évalue à quel point, à partir d'un age et d'un lieu de résidence, l'on est en mesure de déterminer la maladie d'un sujet et donc à quel point, on est en mesure de lui attribuer un traitement à partir de ces attributs

Par exemple dans la table (1) , la connaissance du ZIP Code 35512, suffit pour administrer le traitement de la Malaria (DR = 1). Dans la table (2), la connaissance de l'age 22 suffit pour administrer le traitement du Cancer. (DR = 1)

CONCLUSION

L'évaluation de la qualité des données de santé et un enjeu considérable car elle permettrait entre autres de mieux comprendre les causes de maladies et donc de mieux les traiter. Cependant , elle est difficile à évaluer car elle est subjective et dépend du besoin de celui qui utilise les données. Nous proposons une approche simple et innovante, permettant de capturer un besoin d'utilité et de le mesurer avec une grande finesse.

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L. P. Sondeck, M. Laurent, and V. Frey. Discrimination rate: an attribute-centric metric to measure privacy. Annals of Telecommunications, pages 1–12, 2017.

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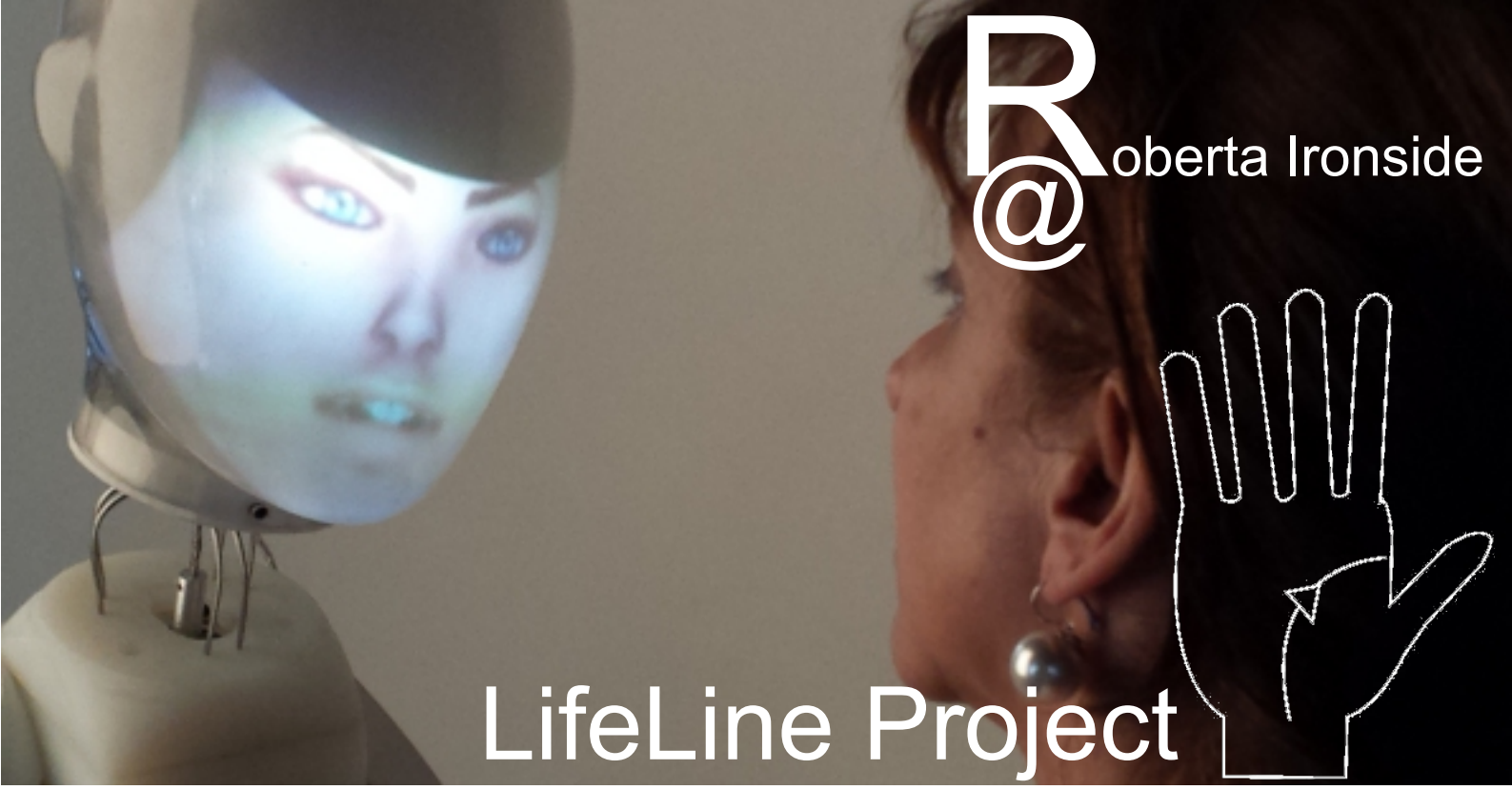

Une oreille bienveillante à qui parler et à qui raconter sa vie pour la postérité

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dijana.petrovska@telecom-sudparis.eu, manes.torres@ehu.es, hugues@shankaa.com

- traitement de la parole,
- sémantique,
- dialogue vocal,
- reconnaissance visuelle du locuteur,
- Wizard of Oz,
- organisation de la connaissance acquise,
- agent conversationnel réifié (robot humanoïde)

First Time Encounters with Roberta: A Humanoid Assistant for Conversational Autobiography Creation

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TRUST MANAGEMENT FOR THE INTERNET OF THINGS

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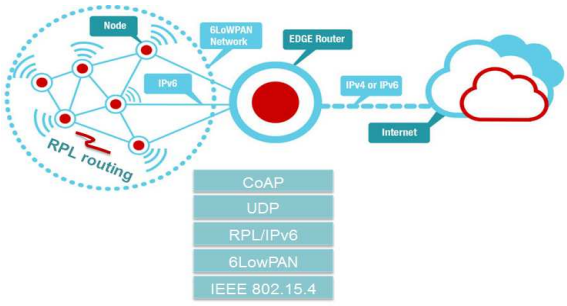
Context

- The Internet of Things (IoT) objects typically collect, communicate and share data that can be used to derive sensitive information and to make decentralized decisions.
- Data packets are transmitted, collected and distributed via RPL, the routing protocol for Low power and Lossy networks considered as the standard protocol of IoT.



Problematic

RPL network is composed of embedded devices with limited power, memory, and processing resources thus their overuse in routing may lead to battery depletion.

The RPL protocol is exposed to a large variety of security attacks causing the loss of a large part of the traffic.

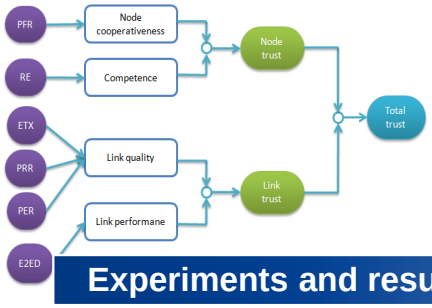
Participating entities may change their behavior which could disturb the network functioning.

- How to extend the battery life of IoT objects?
- How to be sure that the data received are not corrupted by some malicious nodes in the network ?
- How to trust the participating network nodes and how to trust the route data was transmitted over?

Proposed approach

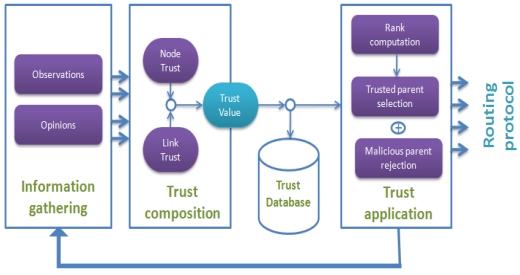
Enhancing the security aspect of RPL routing protocol.

Ensuring Trust among entities by considering Trust related to their forwarding behavior as well as that related to the quality of the connecting link.

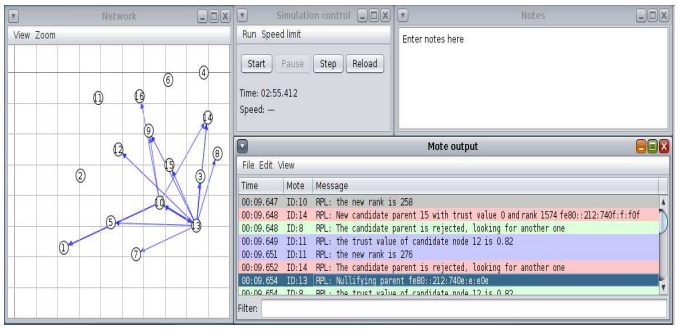


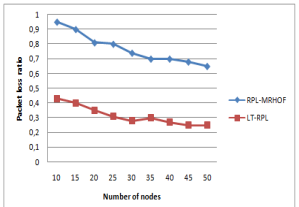
Trust computation is based on a set of properties including the reputation parameters, the energy considerations and the QoS factors.

Integration of the proposed model into the RPL DODAG construction and maintenance phases, Trust values are used for rank computation and thus for preferred parent selection.

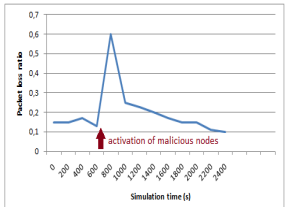


Experiments and results

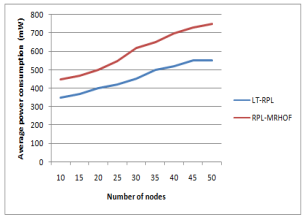




Packet loss ratio comparison between RPL (MRHOF) and LT-RPL under black-hole attacks



Packet loss ratio evolution of LT-RPL in a 50 nodes network size



Influence of the network size on the power consumption

Future Work

- Improving the performance of the proposed model in case of other types of attack scenarios, we may consider the attacks targeting the RPL network traffic as well as the network nodes resources.

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EMPATHIC : Empathic, Expressive, Advanced Virtual Coach to Improve Independent Healthy-Life-Years of the Elderly

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PORTEUR DE LA TECHNO

Descriptif de la technologie

- Coach virtuel qui dialogue avec les seniors en s'adaptant à l'état émotionnel de l'utilisateur
- Interfaces multimodales (audio-visuelles) adaptées aux seniors
- Interaction vocale multilingue: français, espagnol, norvégien, anglais…
- Utilisation des terminaux existants: PC, , télévision, tablette, téléphone mobile…

Applications - Cas d'usage

- Maintien à domicile
- « Coaching »
- Respect de la vie privée

Informations relatives à la valorisation

Business-modèle prévu, maturité, propriété intellectuelle...

Nos partenaires

2014 Bourse aux technologies

Semantic techniques for eHealth IoT data and service management: OntoSmart system

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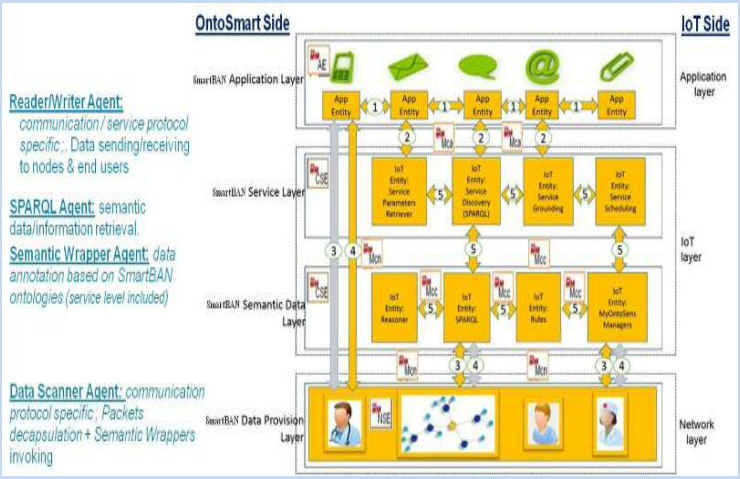
IoT challenges and our proposed solutions

IoT Challenges	Proposed solutions
Interoperability management (*cross-domain included*)	Semantic open data models and associated modular ontologies (*service level included*), syntactic and semantic interoperability (***MyOntoSens and MyOntoService modular ontologies, OntoSmart distributed system***)
Provide everything as Service	Service Oriented Architecture and service level ontology (***MyOntoService modular Ontology***)
Heterogeneous data management	Open semantic data model and associated ontologies (***MyOntoSens modular ontology***)
Heterogeneous devices integration	Data Wrappers and Data Scanners (***OntoSmart distributed system***)
Distributed Processing	Modular ontologies + distributed agents (***OntoSmart distributed system***)
Intelligent Decision Making	Semantic rules and reasoner (***OntoSmart distributed system***)
Security & Privacy	Dedicated classes and agents for security and privacy. (***MyOntoSens modular ontology, OntoSmart distributed system***)

OntoSmart High Level Architecture



IoT/CoAP/oneM2M/ JSON/CBOR

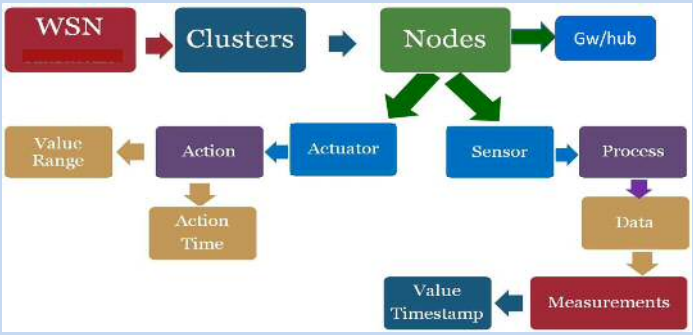
Semantic

Metadata & Modular Ontologies

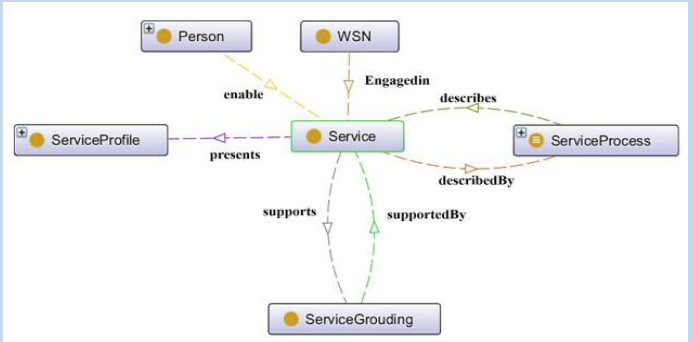
Semantically Embedded Things

- **Restful Protocol**
- **Optional Reliability**
- **Optional Security**
- **Interoperability management** (data/things/syntactic/network/semantic)
- **Semantic discovery/eventing**
- **Caching**
- **Multicasting**

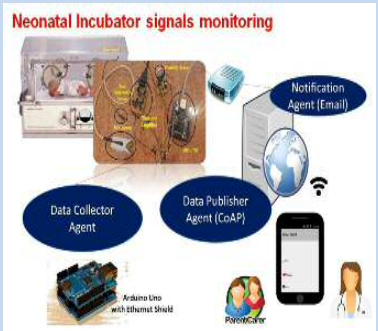
MyOntoSens ontology simplified view

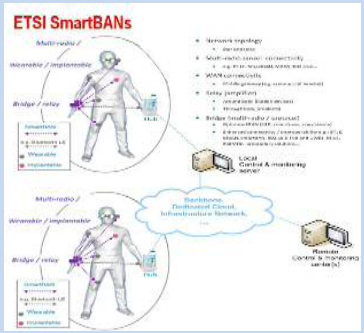


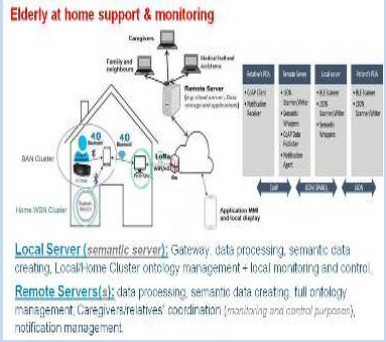
MyOntoService ontology simplified view



Few already addressed application domains: OntoSmart for eHealth







Added values:

Existing Designs:
- Platform dependant
- Sensor specific
- Restricted services
- Heterogeneity problems
- Lack of flexibility

OntoSmart Design:
- Multi platform
- Sensor Interoperability
- Full autonomous services
- Heterogeneity Management
- Ontology-based intelligence with semantic interoperability
- Data reusability
- Nodes & service discovery
- Cross-domain platform

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Variations in handwriting parameters in patients with major and minor neurocognitive disorders

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① BACKGROUND

- Challenges in current diagnosis and treatment in neurocognitive disorders
- Neurocognitive disorders diagnosed at a clinical stage (IRM, LP, NPs)
- Evidence of preclinical stage: Impact of pharmacological interventions? Secondary prevention?
- Lack of evidence on fine parameters relation to illness disclosure

② OBJECTIVES

- To identify variations in handwriting fine parameters patients with major and minor neurocognitive disorders.

③ METHODS

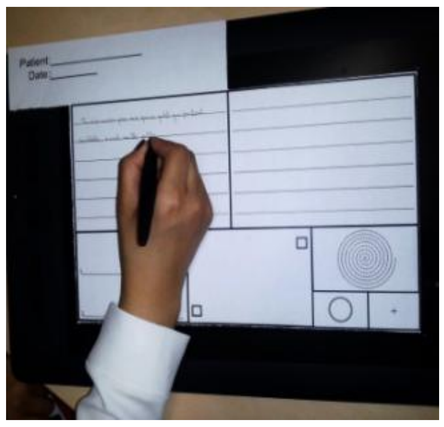


Fig 1. Assessment using the Wacom tablet

Material: Wacom Tablet Intuos Pro Large and Inking Pen (**Fig. 1**)

Protocol: 30-minutes handwriting protocol + 1h cognitive assessment

Participants:

29 Alzheimer's Disease MMSE [20-24] (AD),
87 Mild Cognitive Impairment (MCI)
28 Control group (CG) >65y/o

Extraction of parameters

- Spatial (direction, curvature)
- Dynamics (speed, acceleration, jerk…)

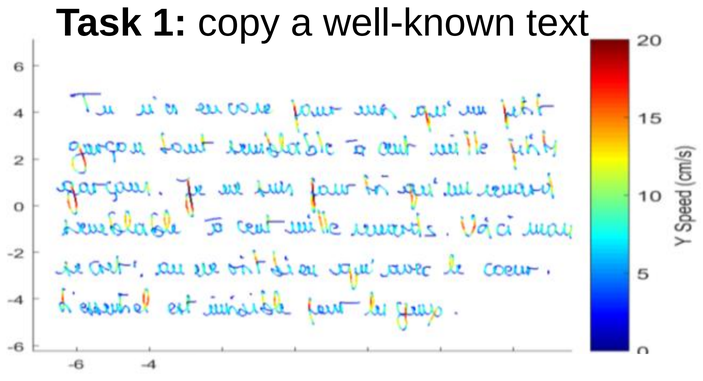
Statistical analysis

- Handwriting (HW): points' sequences : $Z=(x(t),y(t),p(t))t=1..T$
- One-to-one parameters analysis
- Clustering
- Bayesian formalism

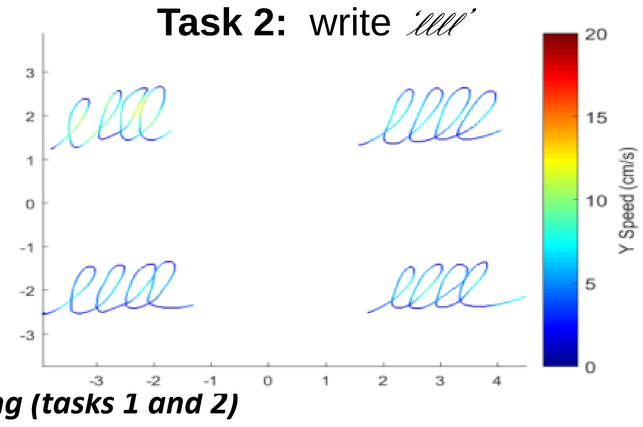
④ RESULTS

	CG (n=28)	MCI (n=87)	AD (n=29)
Age, years mean (Sd)	73,2 (5,7)	78,5 (7,6)	79,9 (6,4)
Gender (% women)	96,4%	65,5%	65%
Level of education (%High school)	96,4%	85,7%	62%
Laterality (% right)	96,4%	94%	89,7%
Frequency handwriting			
Every day many or several times per day	64,3%	60,7%	41,4%
3-6 times per week	17,9%	23,8%	31%
1-2 times per week	17,9%	15,5%	20,7%
Less than 1 time per week	0%	0%	6,9%
Native language (% French)	96,4%	88,1%	82,8%

Task 1: copy a well-known text



Task 2: write 'lllll'



Instantaneous speed during writing (tasks 1 and 2)

Clustering Algorithm : Hierarchical Clustering(HCL) and K-medoids

- **Task 1: Feature selection based on Normalized Mutual Information**

Discretization of parameters in 5 bins and HCL. Criteria : Normalized Mutual information:

$$NMI(X,Y)=\frac{MI(X,Y)}{(H(X)+H(Y))/2}$$

Mutual information (MI) , Entropy (H). In our case : X = Clusters and Y = Classes

→Iterative process to select best features and penalize the raise of number of clusters.

→After application of this criterion, the result in these two cases :

Case 1: CG and AD

	CG	AD	total
Cluster_1	24	6	30
Cluster_2	4	23	27
Nbr Sujets	28	29	57

Case 2 :CG, MCI and AD

	CG	MCI	AD	total
Cluster_1	2	2	5	9
Cluster_2	2	38	21	61
Cluster_3	24	47	3	74
Nbr Sujets	28	87	29	144

Best parameters :

Case 1: Vertical jerk on pen-up, Normalized jerk on pen-up, Nb of strokes* on pen-up, speed on tablet

*Pen trajectory between 2 points such as *Vy*=0

Case 2: Number of points on pen-up such as vertical acceleration *Ay*=0, time between words, vertical jerk on tablet

- **Task 2: Classifying the cognitive profiles : Bayesian formalism on CG vs AD**

$$P(C_k/D_i)=\frac{P(D_i/C_k)\times P(C_k)}{P(D_i)}$$

Where $P(D_i/C_k)=\prod_{j=1}^{Ni}P(B_j^i/C_k)$ and $P(D_i)=\sum_{k=CG,AD}P(D_i/C_k)P(C_k)$

where D_i : loops of person *i*, *Ck* : cognitive profiles (AD, CG)

The closest medoid of the j^{th} loop of person *i*

→ $P(B_j^i/C_k)=\frac{P(C_k/B_j^i)\times P(B_j^i)}{P(C_k)}$ With $P(B_j^i)=\frac{N_{B_j^i}}{N_{Total}}$

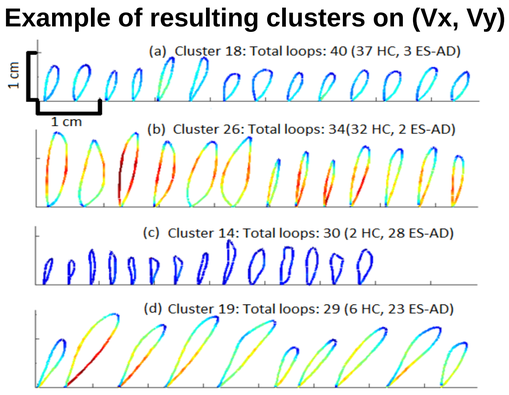
where $N_{B_j^i}$ is the number of loops in cluster B_j^i : (K-medoids), and N_{Total} is the total number of loops (~16 loops x 54 participants)

Likewise, $P(C_k/B_j^i)=\frac{N_k^j}{N_j}$

→ Classification of a given person *i* (producing data D_i) is obtained as:

$$C^*_k=\arg\max_{k=CG,MCI,AD}P(C_k/D_i)$$

Example of resulting clusters on (Vx, Vy)



Correct Classification Rates on the learning Set (LS) and the Validation Set (VS)

Features	Cognitive profile	LS	VS
(Vx,Vy)	All (AD + CG)	83.2.	74
	CG (specificity)	79.3	72.2
	AD (sensibility)	87.1	75.6

Conclusion

- Semi supervised learning
  - Discover automatically relevant features for aid-to-diagnosis
  - Uncover Subgroups with similar behavior (HW style, degradation, etc.)
- HW segmentation + Bayesian Formalism
  - Harness optimally the lack of sufficient training data

Perspectives

- HW segmentation + Bayesian Formalism
  - Harness others features (acceleration, jerk etc.) with Bayesian Formalism
  - Leverage this formalism on the combination of several features
- Longitudinal study
  - How does HW evolve from M0 to M12 and M24