KU LEUVEN

TECHNOLOGIECAMPUS GEEL

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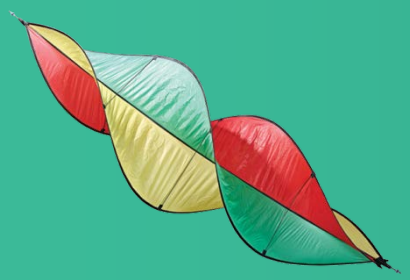
DEVELOPMENT AND EVALUATION OF ASSISTIVE TECHNOLOGY TO IMPROVE CHRONIC CARE



Bert Bonroy

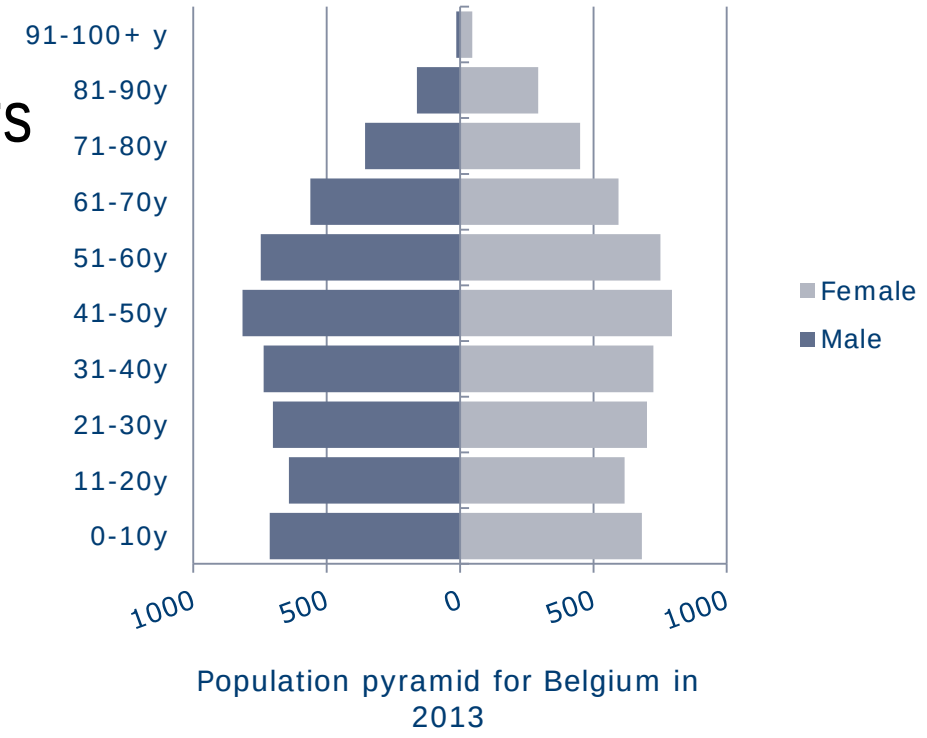
Amies 2015

MOBILAB

- Multidisciplinary expertise-centre
- Bridging Technology and Care
- Demand driven: close cooperation with the field
  - SME's, rehab/care centers, hospitals …
- 4 research lines
  - Active & Healthy ageing
  - Biomedical technology
  - Orthopaedic technology
  - Sports- and rehabilitation technology

INTRODUCTION

- Demographic evolution
  - Ageing population
  - Shortage of caregivers
  - Lifestyle diseases



Population pyramid for Belgium in 2013

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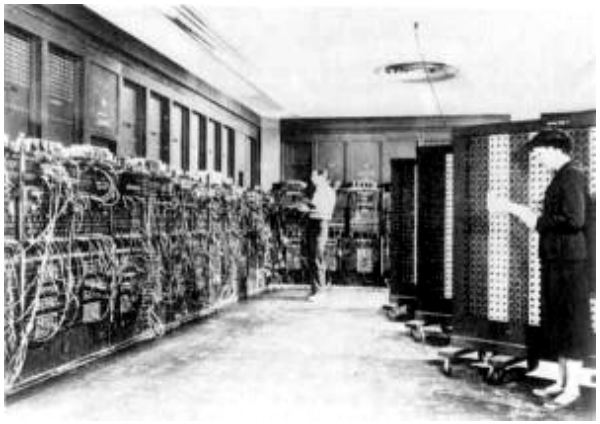
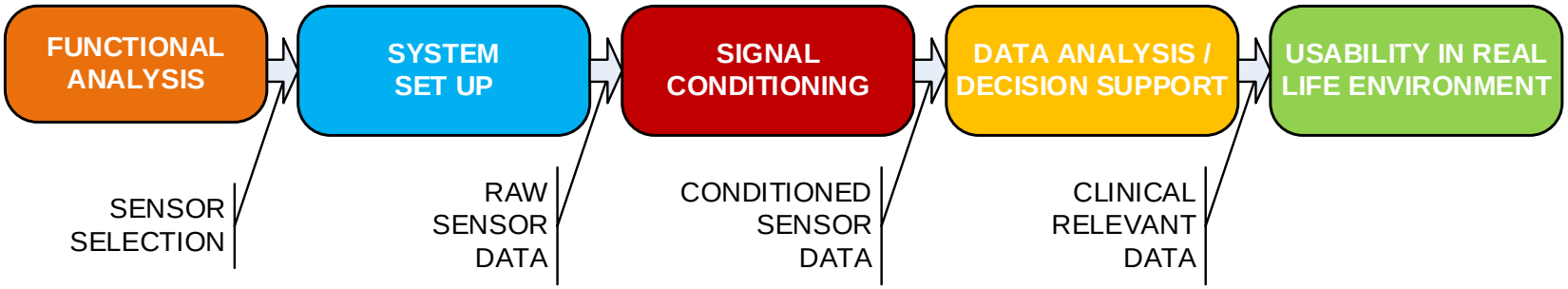
- Technological (r)evolution
  - Telemonitoring
  - mHealth
  - eHealth



- Objective
  - *Developing and evaluating assistive technology to improve chronic care*
  - Five step methodology



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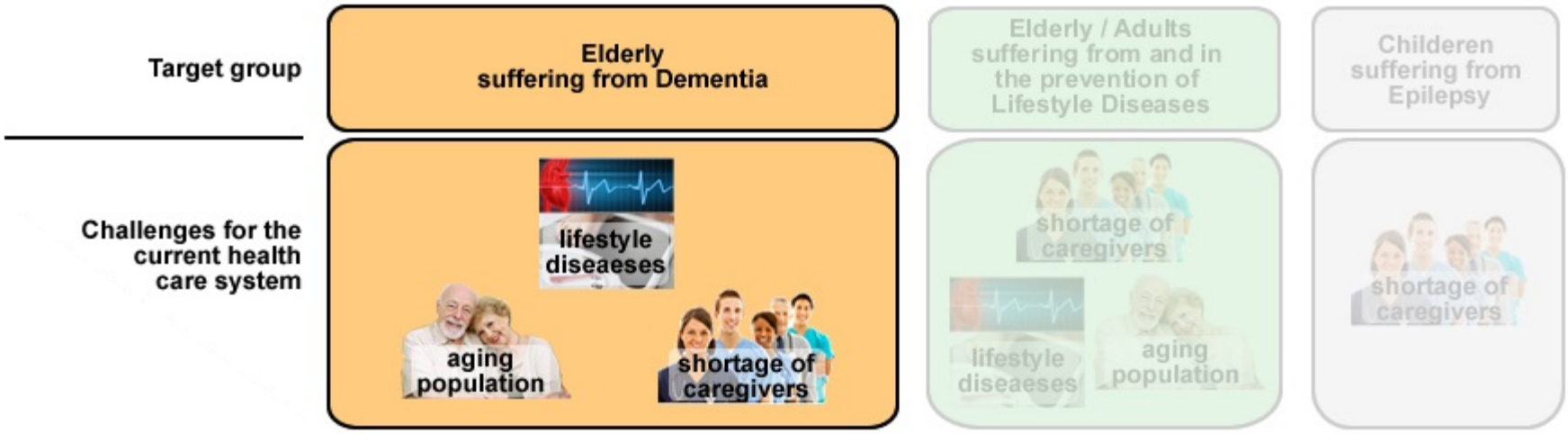
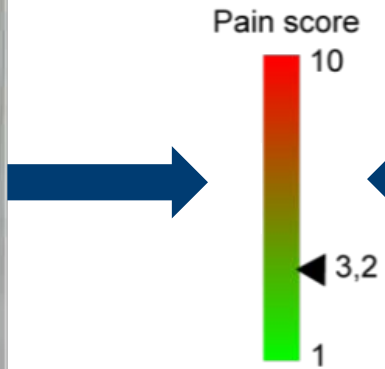
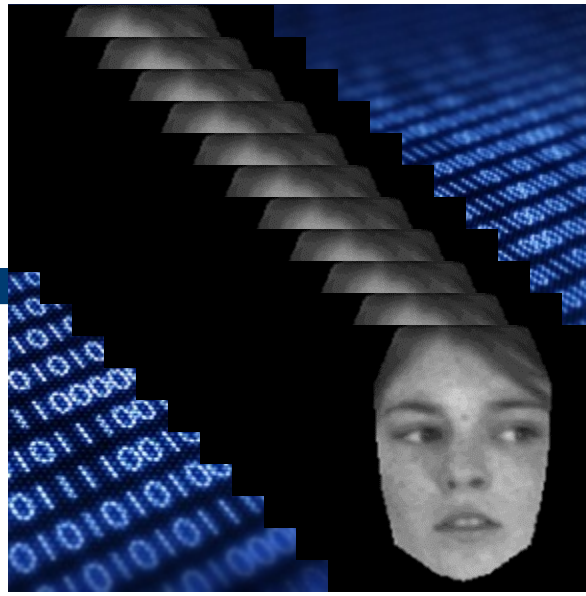
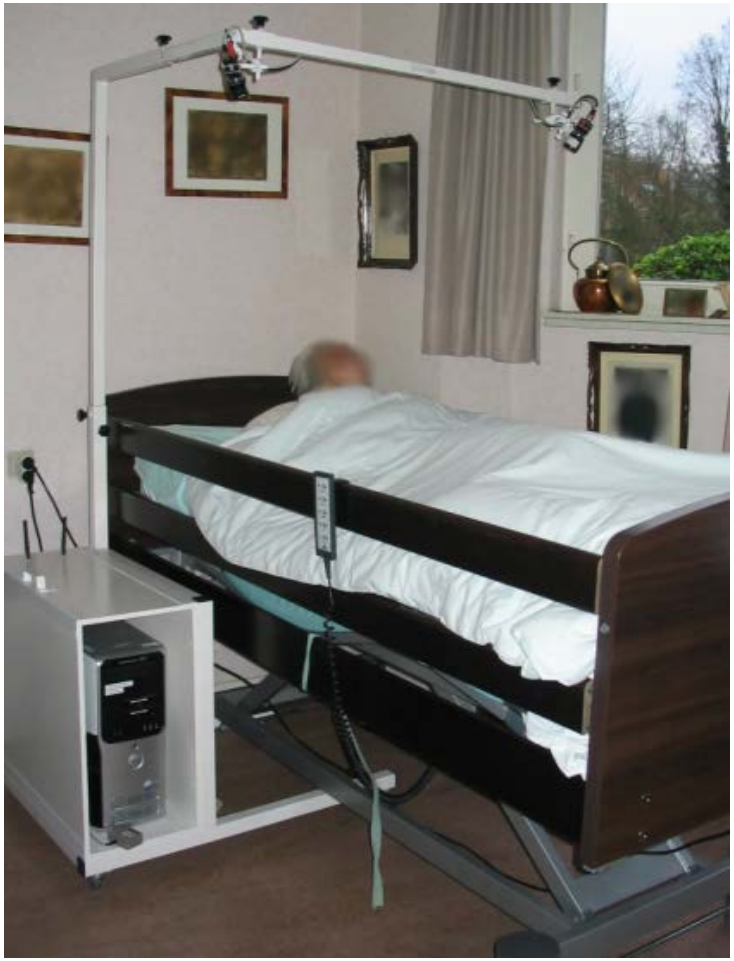
MONITORING OF PAIN IN DEMENTED ELDERLY

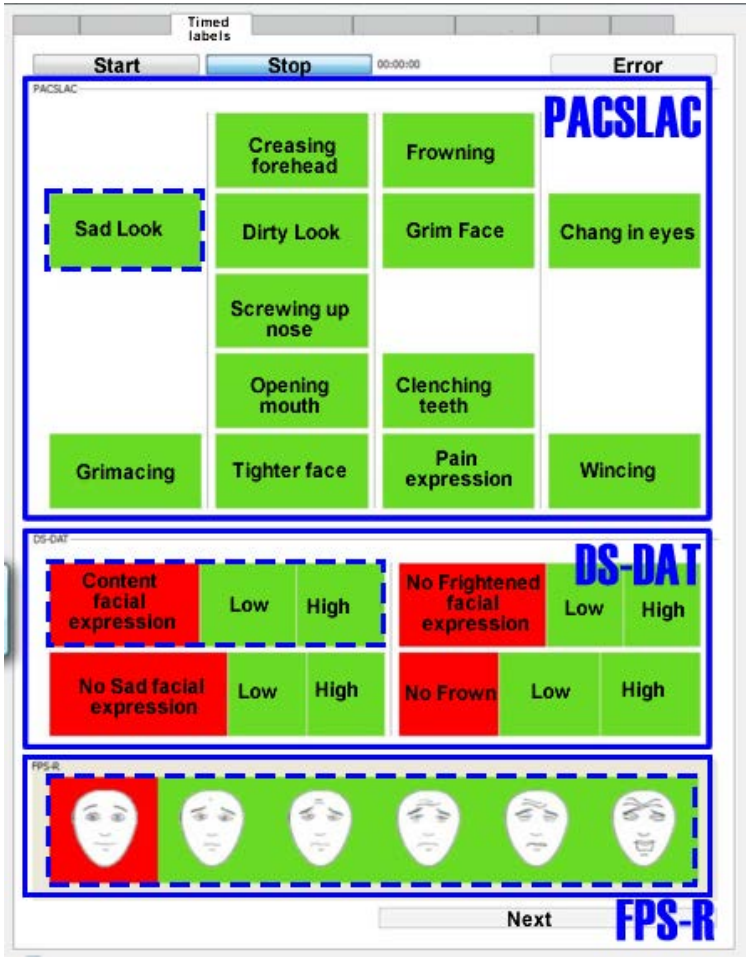






FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → DATA ANALYSIS / DECISION SUPPORT → USABILITY IN REAL LIFE ENVIRONMENT





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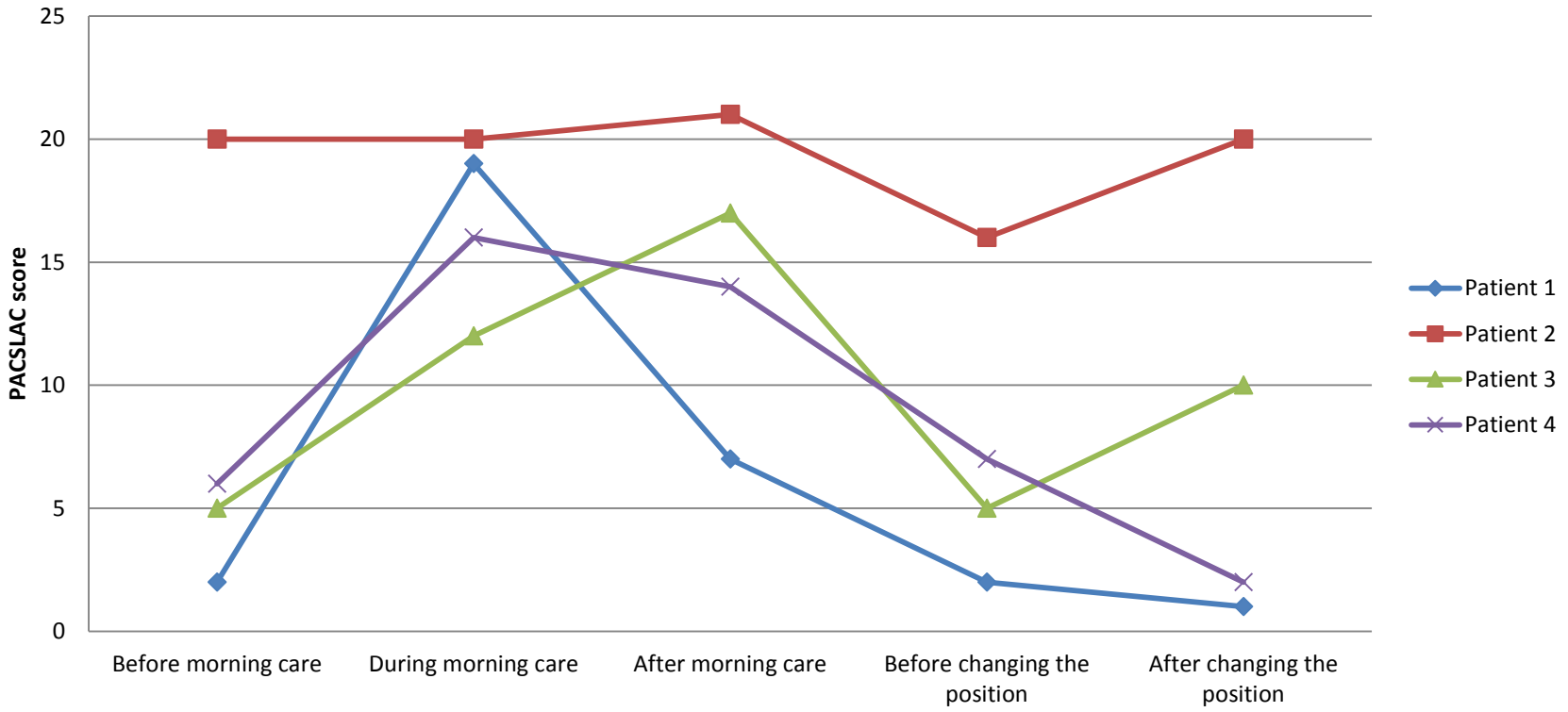

FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → DATA ANALYSIS / DECISION SUPPORT → USABILITY IN REAL LIFE ENVIRONMENT

MONITORING OF PHYSICAL ACTIVITY

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- Number of activities
- Performance of activities (prevention of injuries)
- Positioning for accurate measurement

FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → DATA ANALYSIS / DECISION SUPPORT → USABILITY IN REAL LIFE ENVIRONMENT

FUNCTIONAL ANALYSIS → **SYSTEM SET UP** → SIGNAL CONDITIONING → DATA ANALYSIS / DECISION SUPPORT → USABILITY IN REAL LIFE ENVIRONMENT

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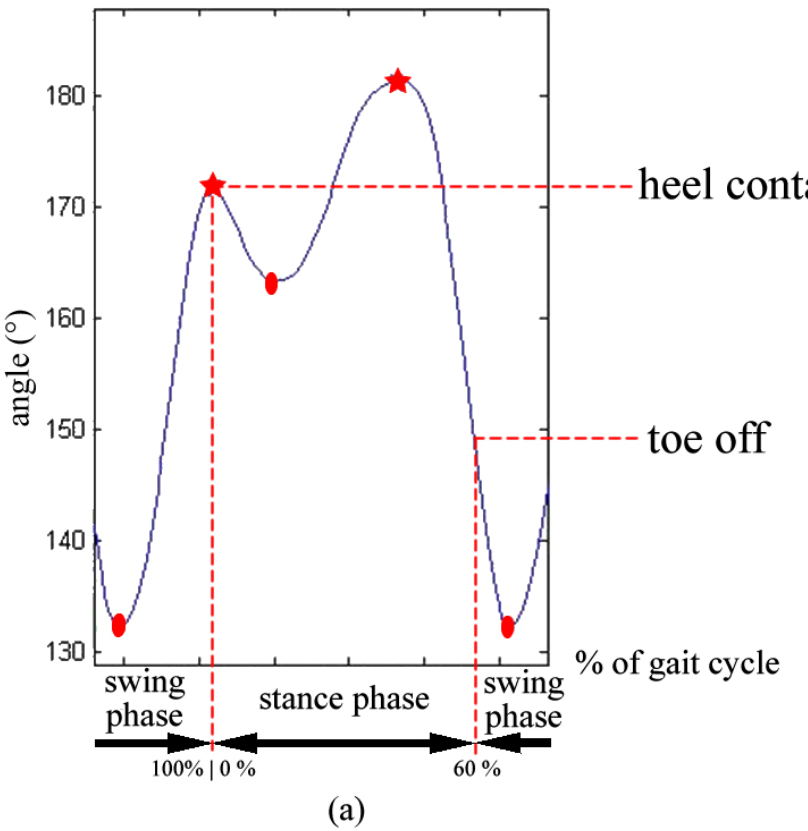
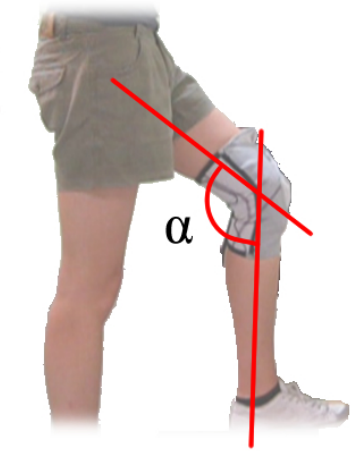


(a)

★ local maximum

● local minimum



(b)

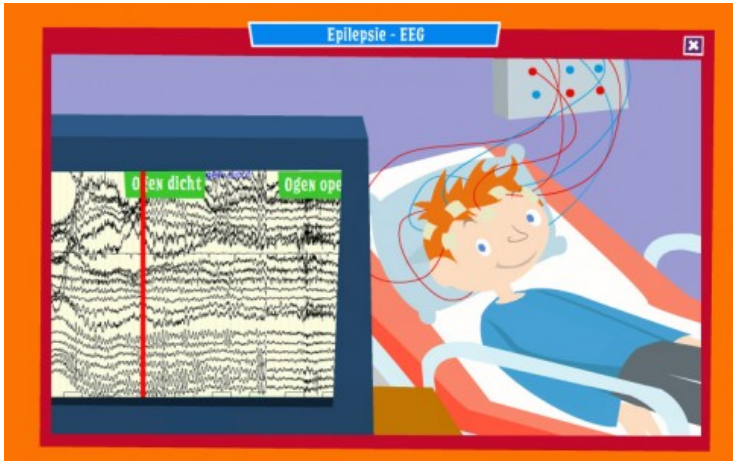
FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → **DATA ANALYSIS / DECISION SUPPORT** → USABILITY IN REAL LIFE ENVIRONMENT

		Predicted				
		normal walking	**stair ascend**	**stair decent**	**fast locomotion**	**no detection**
Labelled	**normal walking**	**95.9** (5979)	0.9 (55)	0.5 (29)	0.3 (23)	2.4 (148)
	stair ascend	1.9 (5)	**90.3** (244)	2.2 (6)	0.4 (1)	5.2 (14)
	stair decent	10.4 (24)	0.4 (1)	**78.3** (180)	5.7 (13)	5.2 (12)
	fast locomotion	4.2 (21)	0.0 (0)	7.0 (35)	**82.2** (410)	6.6 (33)

MONITORING OF NOCTURNAL EVENT IN PAEDIATRIC PATIENTS

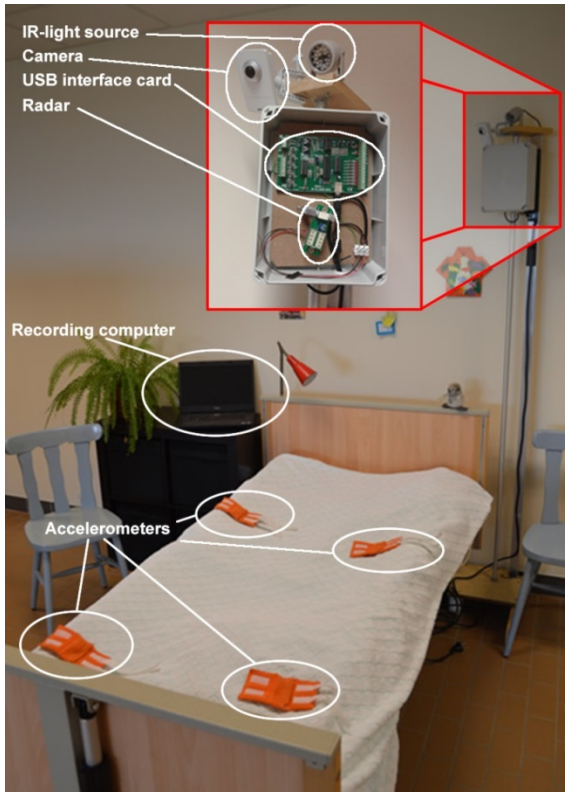
Target group	Elderly suffering from Dementia	Elderly / Adults suffering from and in the prevention of Lifestyle Diseases	Childeren suffering from Epilepsy
Challenges for the current health care system	lifestyle diseaeses aging population shortage of caregivers	shortage of caregivers lifestyle diseaeses aging population	 shortage of caregivers

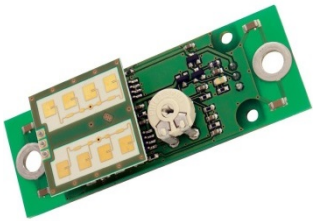
- video EEG = gold standard monitoring[1]
  - not interesting and uncomfortable for prolonged observations
  - long waiting lists in specialized centers

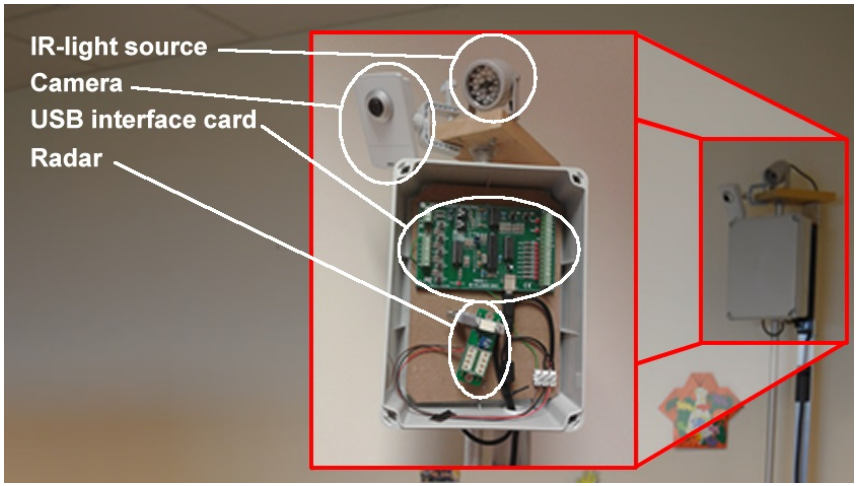


[1] Casson et al., 2010

FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → DATA ANALYSIS / DECISION SUPPORT → USABILITY IN REAL LIFE ENVIRONMENT







FUNCTIONAL ANALYSIS → **SYSTEM SET UP** → SIGNAL CONDITIONING → DATA ANALYSIS / DECISION SUPPORT → USABILITY IN REAL LIFE ENVIRONMENT

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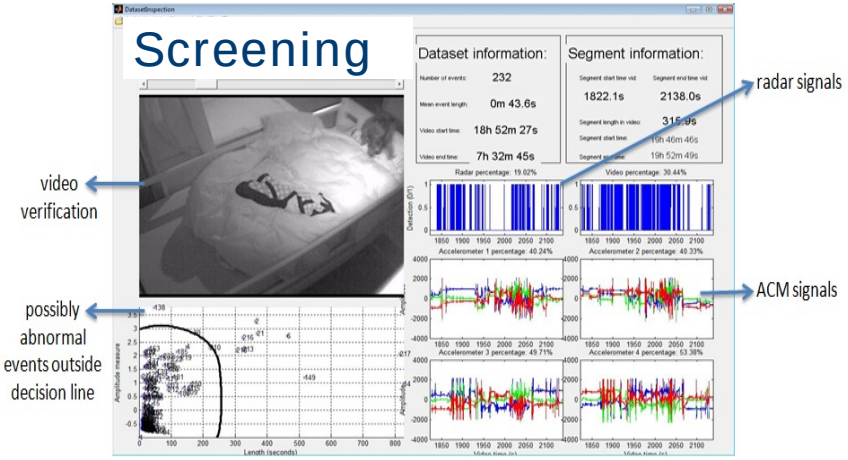
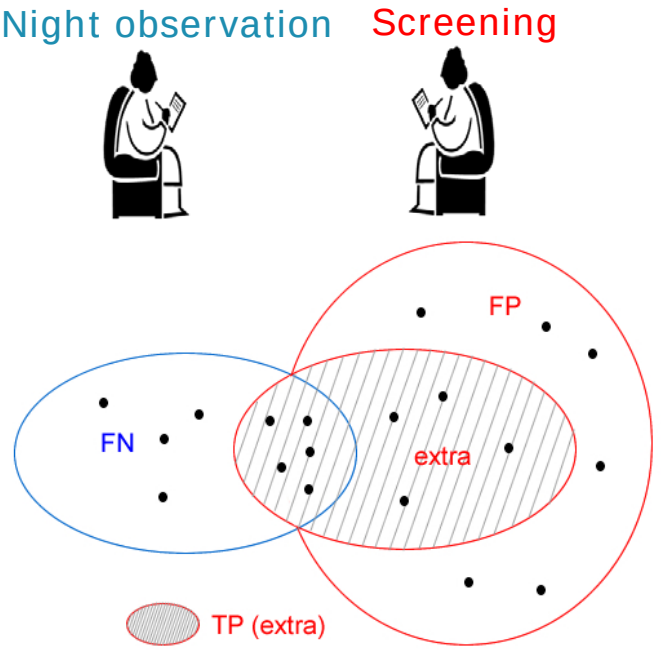


FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → **DATA ANALYSIS / DECISION SUPPORT** → USABILITY IN REAL LIFE ENVIRONMENT

	TP (extra)	FN	Sens (%)	FP
subject 1	46 (25)	37	55.42	26
subject 2	7 (6)	2	77.78	151
subject 3	9 (3)	13	40.91	102
subject 4	8 (3)	6	57.14	88
total	***70 (37)***	***58***	***-***	***367***
mean	***17.50 (9.25)***	***14.50***	***57.81***	***91.75***

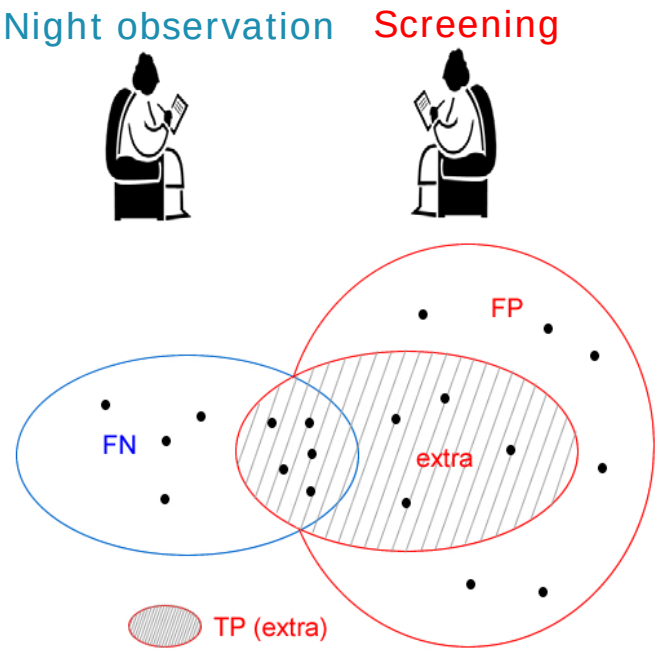
Sens = TP/(TP+FN)

95% outlier threshold



FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → **DATA ANALYSIS / DECISION SUPPORT** → USABILITY IN REAL LIFE ENVIRONMENT

- Upgrading segments
  - Increasing sensitivity from 57,81% to 67,30%
  - 72 extra seizures,
  - 44 missed



FUNCTIONAL ANALYSIS → SYSTEM SET UP → SIGNAL CONDITIONING → DATA ANALYSIS / DECISION SUPPORT → USABILITY IN REAL LIFE ENVIRONMENT

CHALLENGES FOR ASSISTIVE TECHNOLOGY

- Scientific evidence
- Adaptation of the current healthcare
  - Patient
  - Caregiver
  - Government
  - Healthcare providers, social and economic organisations and the society

DO'S AND DON'TS

- Use off-the-shelf technology
- Use simple processing algorithms
- Evaluate in a real-life setting
- Educate to change behaviour
- Integrate technology in existing medical protocol

CONCLUSION

- Use of **existing technology** already make it possible **today** to deliver a **positive contribution** to **chronic care**

- We can **develop and evaluate** comfortable monitoring systems that provide useful (clinical) information and added value

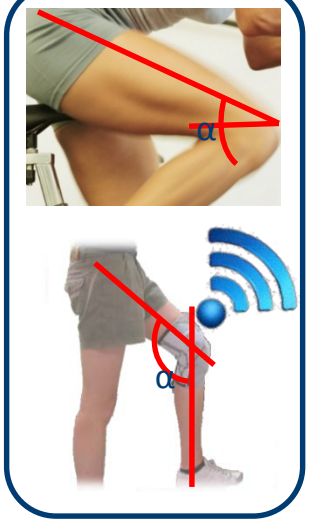
- Regarding challenges, there is a need for more **scientific evidence** and an **adaptation of the health care system** is required.

MOTEX

Smart textiles

Monitoring validation

Feedback



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CENTEXBEL

Fraunhofer IZM

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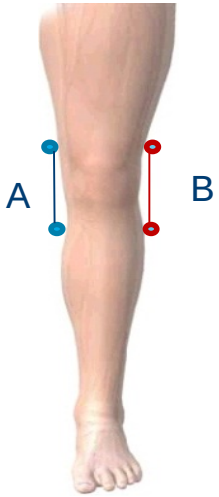
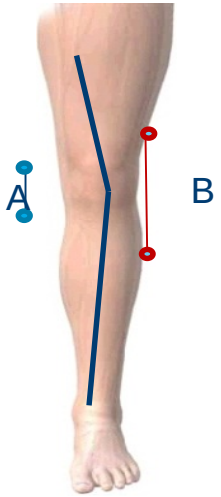
CLINICAL STUDY: PHASE 1 PROTOTYPE VALIDATION

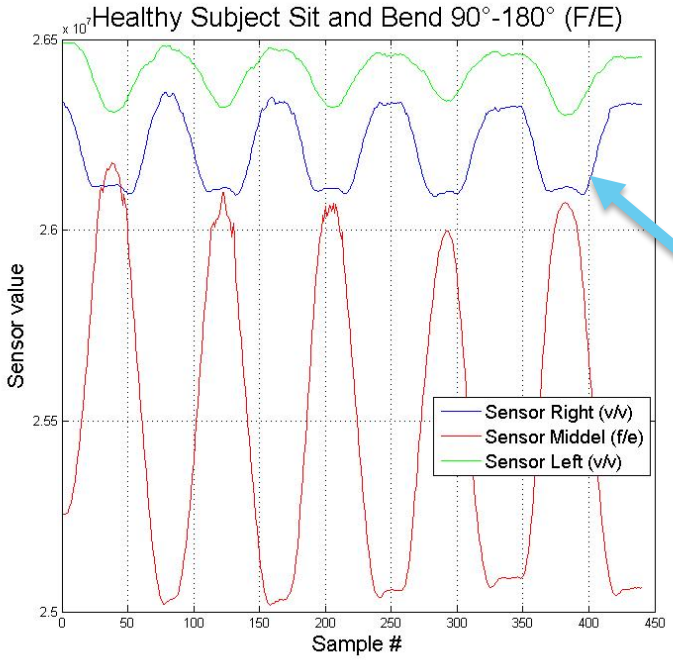


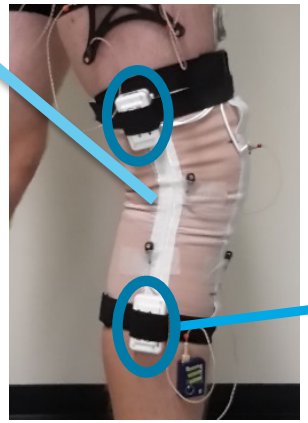
VV = A – B (≈0)

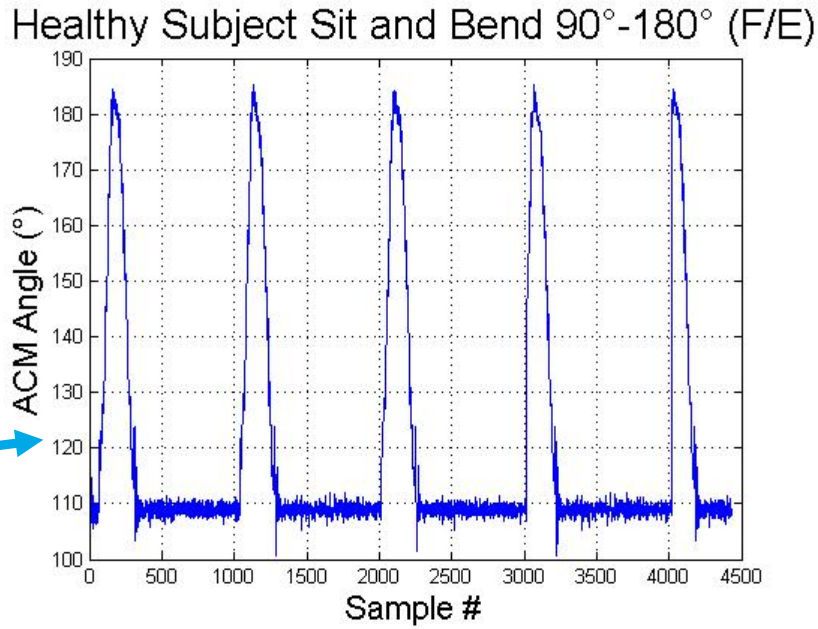


VV = A – B (< 0)

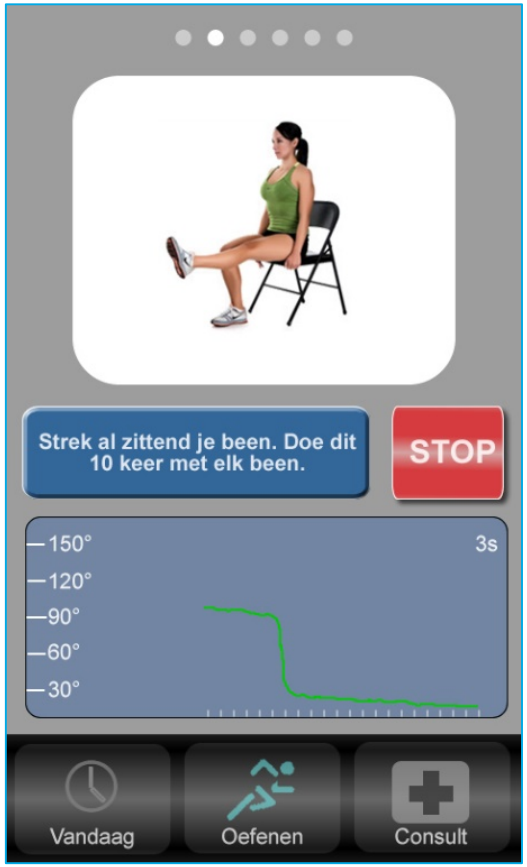
CLINICAL STUDY: PHASE 1 PROTOTYPE VALIDATION

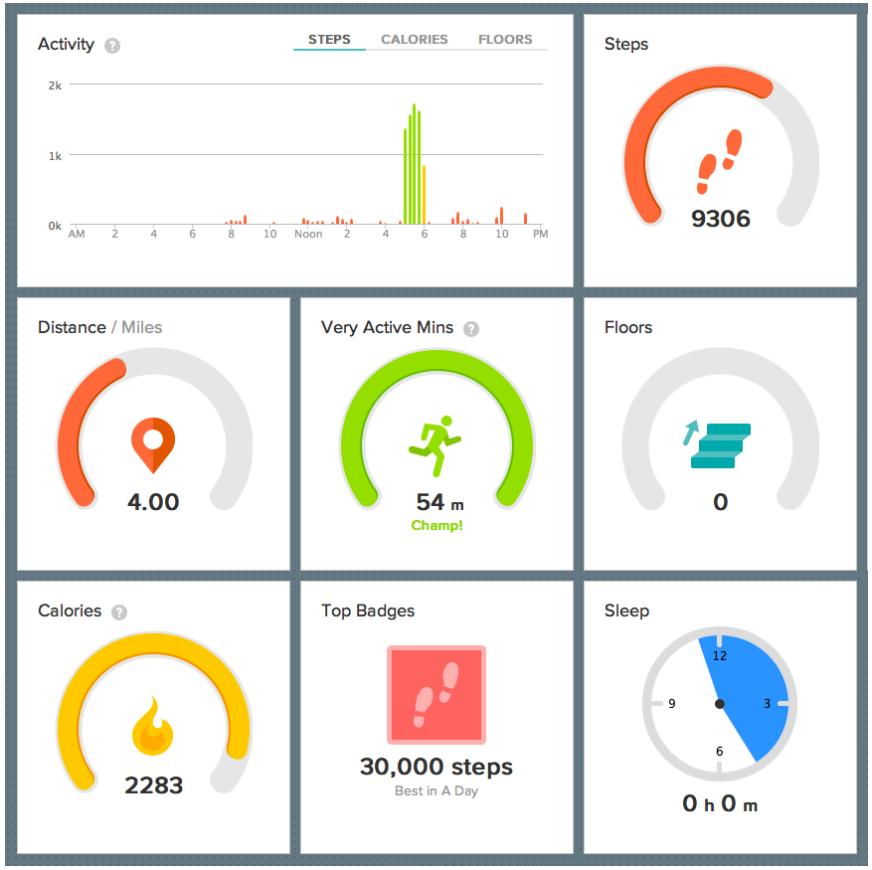






MOTEX APP & DASHBOARD





Questions