Fully Wireless Insoles for Monitoring Fall risk Index (FRI)

Joint Medical + ICT R&D Experience in the framework of the FP7 European Project Wiisel (www.wiisel.eu)

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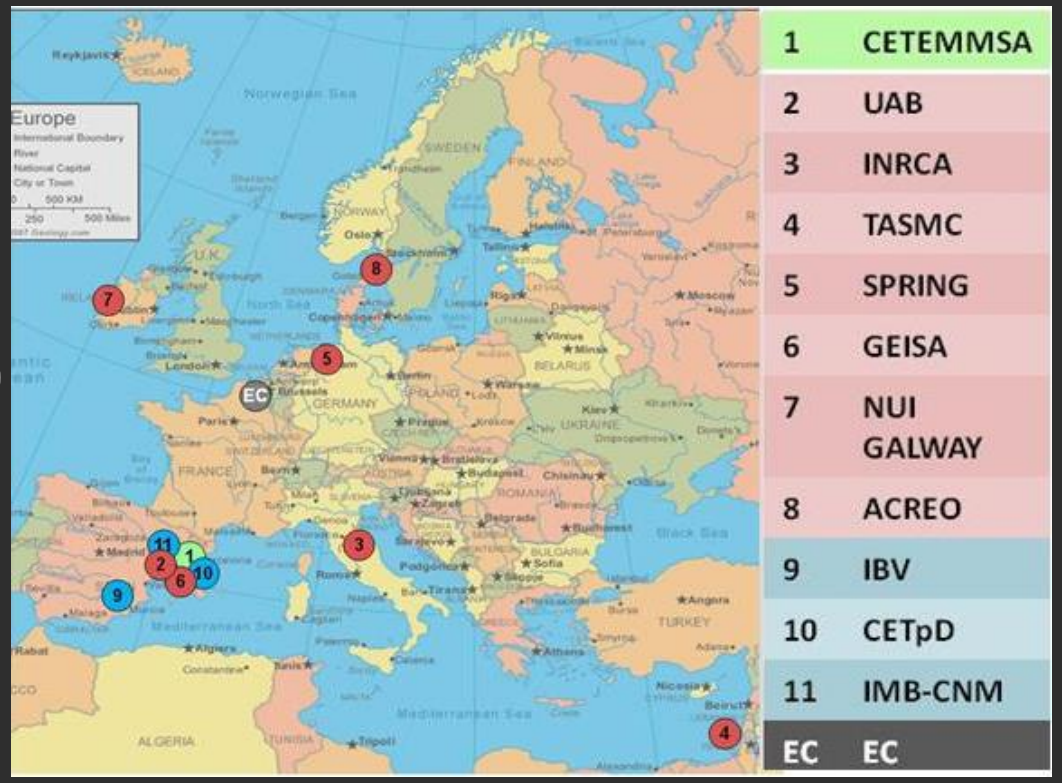
WIISEL (FP7 – ICT) Project Facts & Figures

- Title: Wireless Insole for Independent and Safe Elderly Living
- Period: 1/9/2013 to 31/3/2015
- Budget: 3.9M€ (2.9M€funding)
- Web site: www.wiisel.eu
- Leader: CETEMMSA (now EURECAT)
- 8 partners + 3 subcontractors



Clinical partners: The Tel Aviv Sourasky Medical Center; NUI Galway OÉ Gaillimh

Research partners: CETEMMSA TECHNOLOGICAL CENTRE; UAB; acreo

Industrial partners: spring techno; geisa

Subcontractors:

Algorithms WPs 1-2-4	Ergonomic optimization WPs 1-2-3	Multi-technology integration WP 2

WIISEL Final VIDEO.mov

Addres

- ***Build*** a f
  gait data
  related
  populati
  - **Conti**
    insole
  - **Fall**
    recog
  - R&D
  - Plann

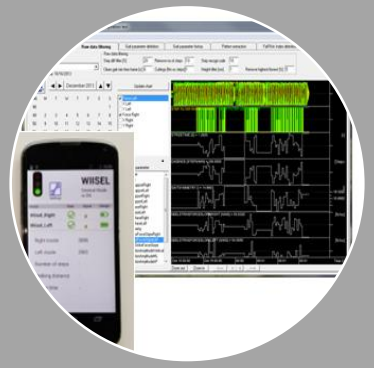
INSOLE TECHNLOGY

CETEMMSA

UAB

ACREO

GEISA



DATA MANAGEMENT

SPRING

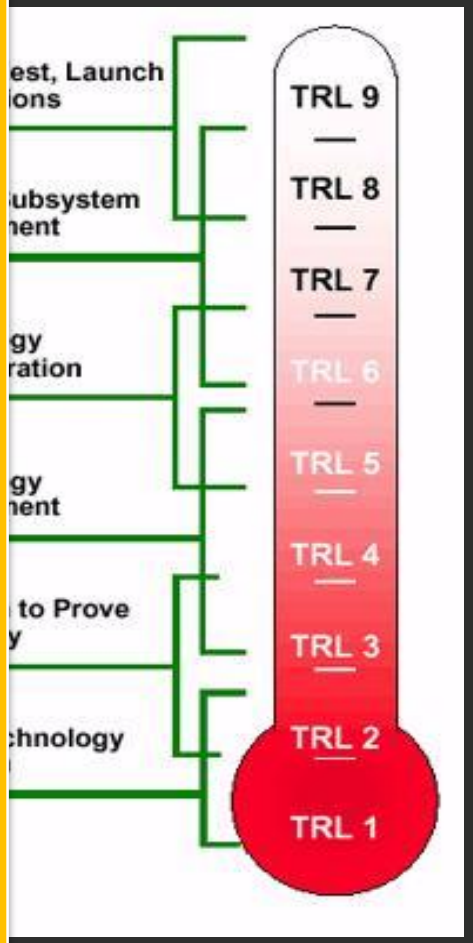
ACREO

MEDICAL VALIDATION

NUI GALWAY

INRCA

TASMC



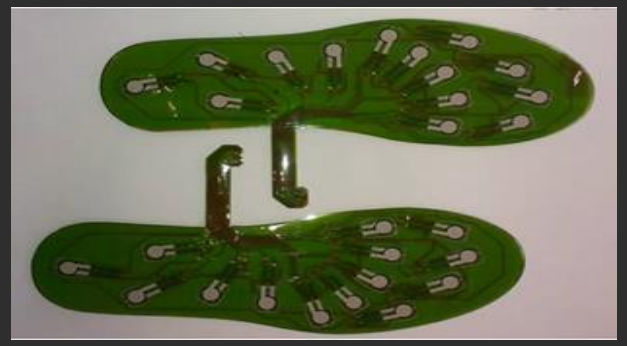
TRL = Technology Readiness Level

Commercial Solutions for Wireless Motion Detection & Gait Analysis

Device name and company	Application	Sensors	P [kPa] Range	RA[1] [KPa]	IE[2]	Acq[3] [Hz]	D[4]	BA[5] [h]	Price
WISEL	Continuous gait monitoring, analysis and fall risk assessment	piezoresistive (14) Inertial	350	0.34	Yes	33.3	BLE	16	Pending
Pedar By Novel	Footwear design and injury prevention	pressure (99)	600	2.5	No	100	BT	1	15,450€
F-Scan (insole) By Tekscan	gait analysis & biomechanics, diabetic offloading , sports medicine	pressure (960)	862		No	165	USB Wifi	0.2	16,000$
BioFoot By IBV	Sports Gait analysis Footwear design	pressure (64)	1200	0.1	No	500	Wire WiFi	1	12,995 €
paroLogg/paro Tecc by paromed	Foot pressure analysis	Pressure (32) Inertial	625		No	300	Wifi	1.5	
Foot Pressure MS By Medilogic	Gait, Sports, Health Prevention, Prosthesis and Orthotics, Diabetics	SSR sensors (240)	640		No	300	Wirel ess		
SmartStep™	rehabilitation process				No		Card		6,000$
SmartInsoles™ By 24eight, LLC	medical, sports and gaming	Pressure (4) Inertial	241		Yes		wirel ess	~100	
OpenGo science By Moticon	Medical and sports science Rehabilitation and training analysis	Pressure (13) Inertial, Temp	400	2.5	Yes	100	Wire-less		2,000 €
Footswitches Insole from B&L Engineering	Gait analysis	4 pressure sensors			No		Wire-less		299$ + 9,000$ SW

[1] Resolution & Accuracy,[2] Integrated Electronics,[3]Max Data acquisition rate, [4] Data Transfer Type, [5]Battery Autonomy

WIISEL Wireless Insoles

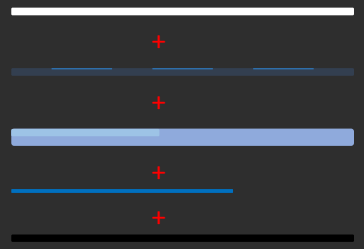


Electronics

14 pressure sensors
3D Gyroscope/Accelerometer
Flexible PCB
Semiflexible Battery
Bluetooth low energy 4.0
Qi Inductive charge

Material layers :

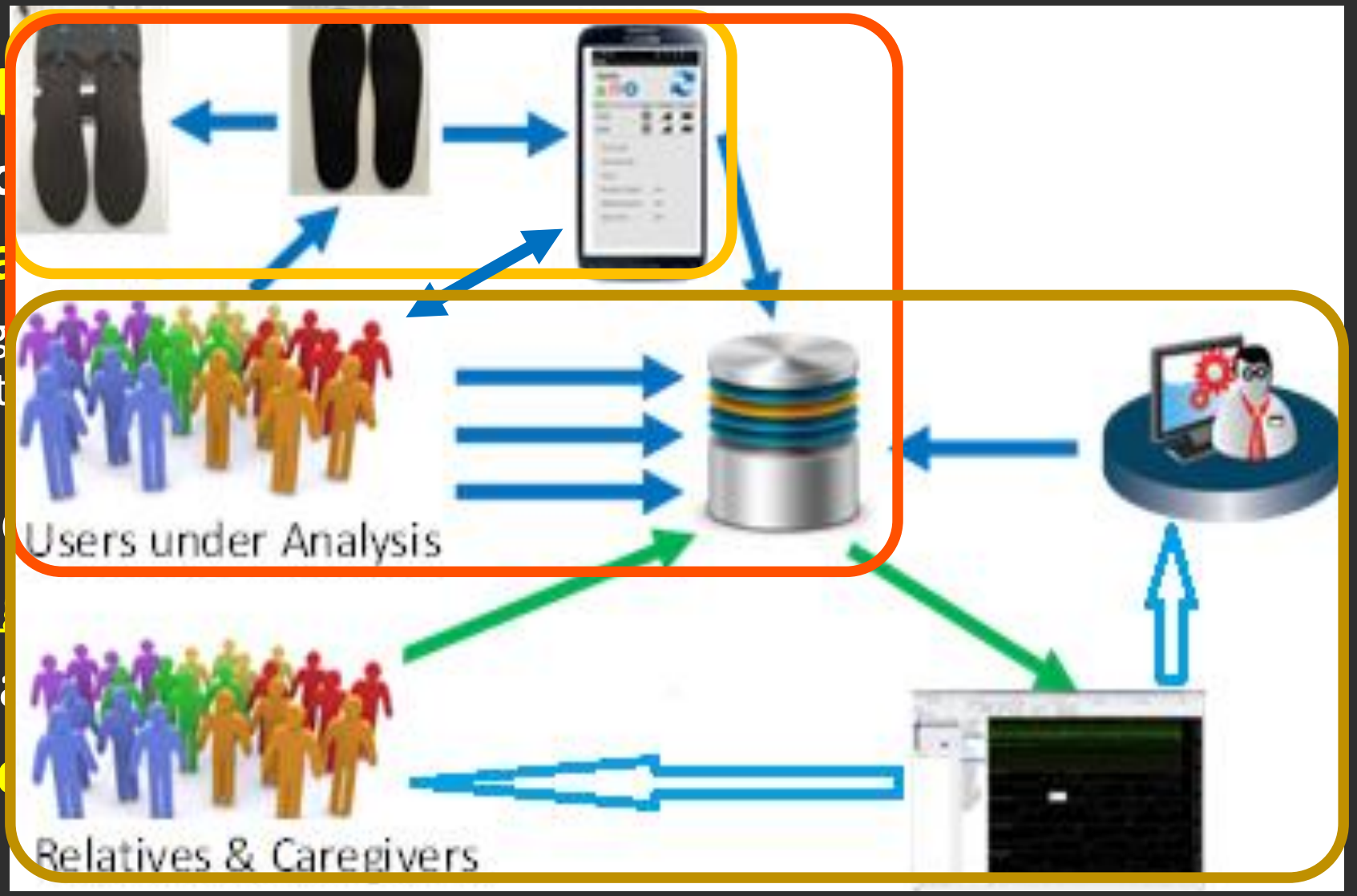
Artificial leather →
Pressure Sensors+PU →
EVA+Electronic layer →
Rigid fiber →
EVA →



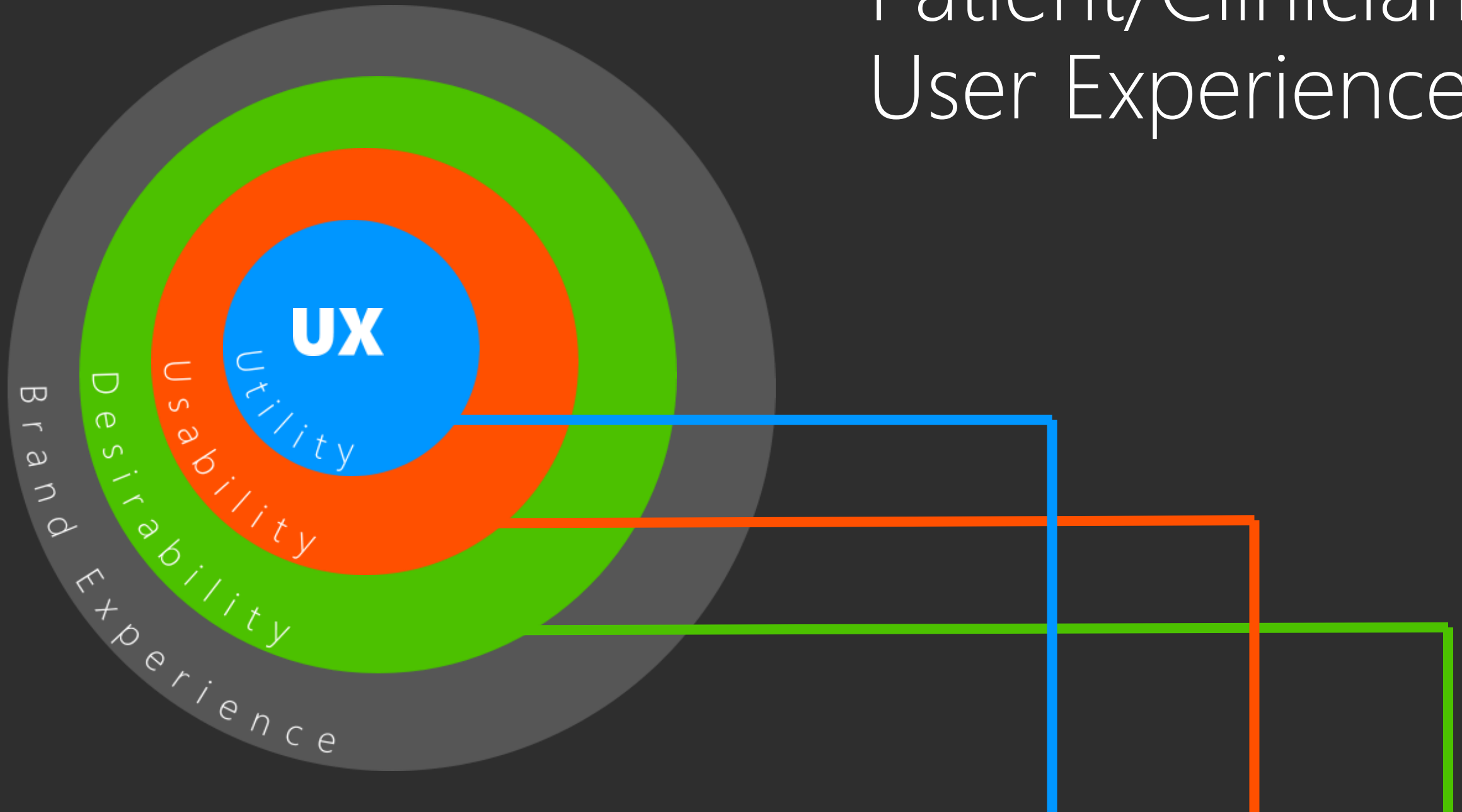
System Description

- A **wearable and**
  - **Easy to wear, c**
- **Continuously ca**

  stride time, sing
  steps per day, st
  pressure values
- **To obtaing Larg**
  - **Real-life & lon**
- **With a highly pa**
- **That allows a Pe**



Patient/Clinician User Experience



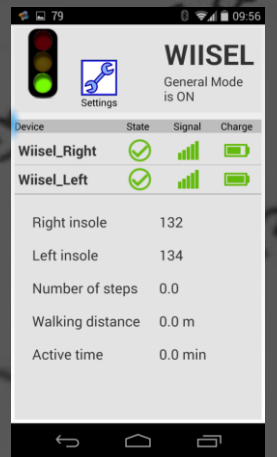
Utility: Validation

- Refers to the ability of the product to perform a task
- Elderly volunteers at 3 clinician sites
- Addressed aims:
  - (1) Assess the **comfort and durability** of the insole,
  - (2) evaluate the **functionality** in **collecting gait data**,
  - (3) **measure & recognition of walking patterns**, activity and sedentary periods and to **identify risky behaviors**,
  - (4) assess the users' feasibility to **operate at home**
  - (5) evaluate the usability

- 2 clinical phases:
  - Pilot: 3 days of assessment (1 in a laboratory + 2 at home)
  - Validation: ~2 weeks for patient's daily living with weak support

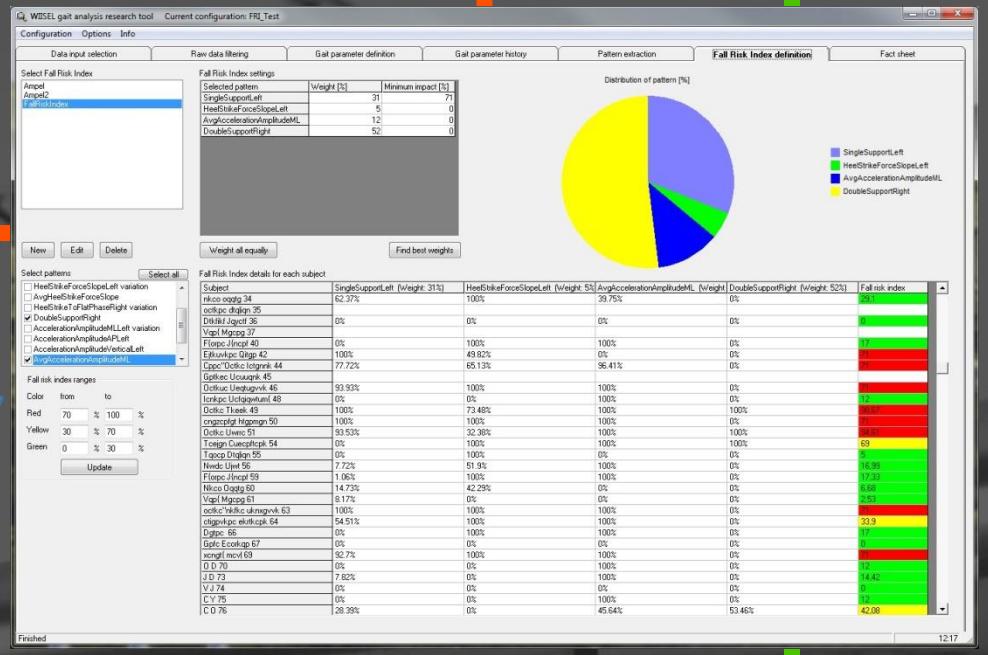
Usability: Patients

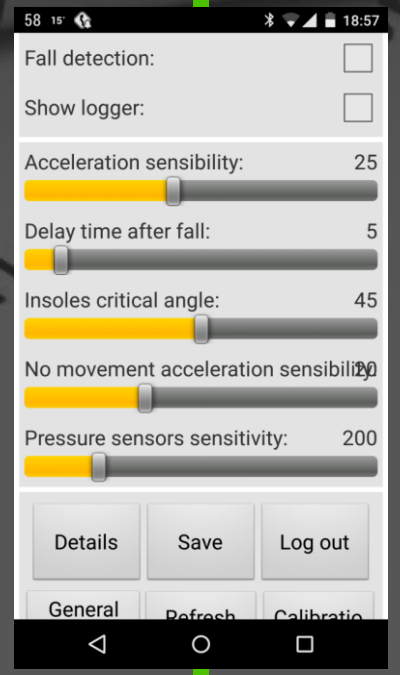
- Extent to which a system, product or service can be used by specified users **to achieve specified goals with effectiveness, efficiency and satisfaction** in a specified context of use
- **Patient**: **Comfort Wearing Insoles + Smartphone**
  - 6 experts carried out an ergonomic inspection of insoles
  - 10 volunteers carried out a controlled comfort study
  - App UI Evolution



Usability: Clinicians

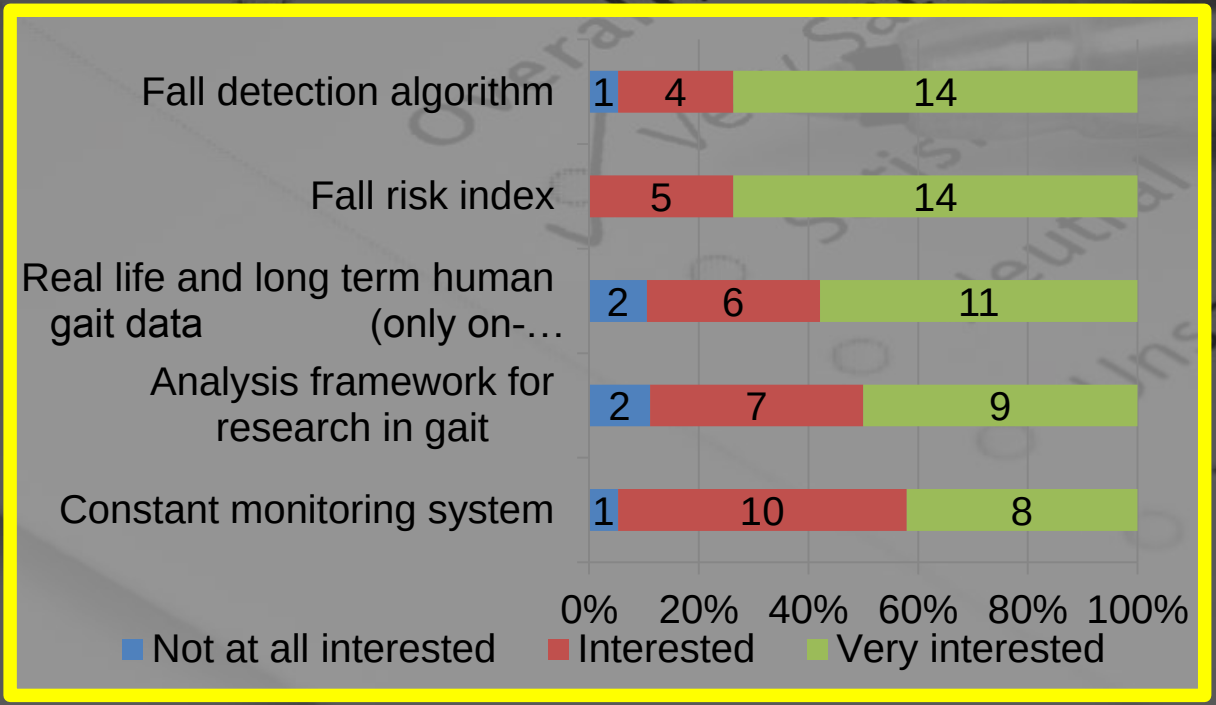
- Clinicians:
  - Complete collection of gait parameters
  - Robust against Connection breaks
  - Fall detection without false positives
  - New FRI with sensitivity parameters
  - Results consistent with “gold” Standards
  - Big Data Architecture for parallel uploads
  - Individual Fact sheet





Desirability: Clinicians

- "I like the way the product looks and feels"
- Experts WIISEL Surveys: Interest



Desirability: Experts

- Experts' WIISEL Surveys: Details

Desired Characteristic	Frequency
In real life settings	22
Constant monitoring	13
Through wearable and unobtrusive device	12
Long term monitoring	11
Measurement of multiple parameters	9
Facility to include new functionalities	4
Other: Variability	1

Conclusions

What WIISEL have achieved

- WIISEL system is useful for studying fall risk and as a clinical tool for long-term monitoring in the home and community settings, saving time and cost
- Wireless insoles are easier to use than wired insoles
- User's acceptance is encouraging
- Flexible SW platform adaptable to any users' group
- New Fall Risk Index captures fall risk similar that conventional performance-based tests like the Tinetti gait and balance test and the Dynamic Gait Index.

Facts

- 657 hours collecting data
  - 15 subjects tested during pilot
  - 39 subjects tested during validation studies
- 16 experts tested the usability/ergonomics

- 180 insoles manufactured (different phases)
  - 22 Smartphones (Nexus 4)
  - 15 Battery extenders
  - 35 Inductive Chargers & adapters

Current cost of WIISEL pair of insoles ~ 800€

Scientists and researchers experts in gait, posture and movement analysis, fall prevention and intervention

On-going Development

- Update the insole platform to decrease cost and increase reliability to address a wider market
  - Use new wireless protocols for data transfer and charging
- Validate the system on a wider population set
- Develop and validate a service model

- Move from TRL5-6 to TRL9-10
  - Specific applictions in ageing, geriatric deontology, clinicians (geriatricians, neurologists), specialists in orthopaedics, allied health professionals, care providers, rehabilitation & clinical care, research for insurances
  - Non-clinical context: researchers & scientists in sports, arts performers, military, high-risk workers, wearable ehealth devices, smart homes, etc.

Moltes gràcies per la vostra atenció