

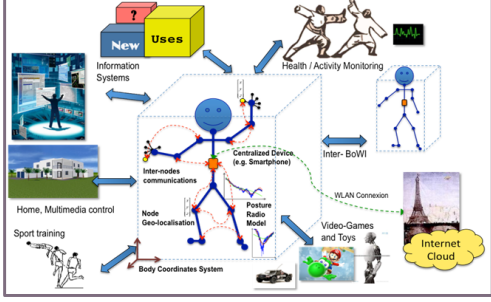


BoWI+: Body Area Network Solution For Musculoskeletal Disorders Risk Assessment

Jean Philippe Diguët (Lab_STICC/MOCS)
Christian Roland (Lab_STICC/IAS)
Alexis Aulery (Lab_STICC/MOCS)
Olivier Sentieys (INRIA/CAIRN)
Arnaud Carer (INRIA/CAIRN)
Mickael Le Gentil (INRIA/CAIRN)
Pierre Halle (INRIA/CAIRN)



Context



- ✓ Musculoskeletal Disorder (MSD) is the first occupational disease cause
- ✓ Body Area Network aim to be embedded in garment with future technology
- ✓ No optical or external device used for non intrusive solution
- ✓ Real time or short term feedback possible by daily monitoring
- ✓ Long term prediction possible with massive data collection
- ✓ Public health strategy for prevention of MSD could be set up with reliable prediction

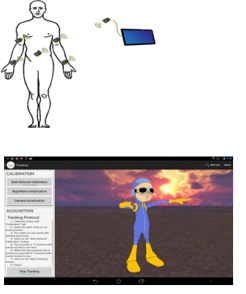
Zyggie Node

- Sensors
 - IMU (MEMS)
 - Acc, Mag, Gyr
 - Distance
 - UWB ToA
- USB
 - Supply
 - Data transfer
- Micro-Processor
 - EFM32 Cortex M4 (FPU)
- Radio
 - Atemega 128RF
- Battery
 - Li-po 300mAh
 - Several h. autonomy



Network & App

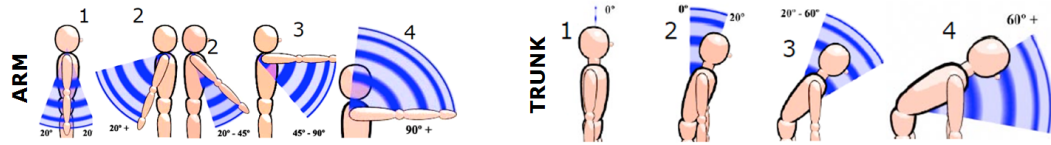
- Topology
 - Full mesh
 - 1 Gateway (USB)
- Protocol
 - Zigbee based (802.15.4)
- Range
 - Indoor 10-20m
 - Outdoor >100m
- Android App
 - Multiple scenario
 - Posture
 - Geoloc
 - Multiple Mode
 - RT Monitoring
 - Recording



MSD Risk And Penibility Assessment

Use of RULA method for risk assessment

- Scoring system with corresponding intervention level
 - Posture score using angle estimation with threshold
 - Muscle score by detection of static postures and repetition
 - Force score if weight is lifted or related effort



- Action level 1**
A score of 1 or 2 indicates that posture is acceptable if it is not maintained or repeated for long periods.
- Action level 2**
A score of 3 or 4 indicates that further investigation is needed and changes may be required.
- Action level 3**
A score of 5 or 6 indicates that investigation and changes are required soon.
- Action level 4**
A score of 7 indicates that investigation and changes are required immediately

		Neck, trunk and legs score						
		1	2	3	4	5	6	7+
Arms score	1	1	2	3	3	4	5	5
	2	2	2	3	4	4	5	5
	3	3	3	3	4	4	5	6
	4	3	3	3	4	5	6	6
	5	4	4	4	5	6	7	7
	6	4	4	5	6	6	7	7
	7	5	5	6	6	7	7	7
	8	5	5	6	7	7	7	7
		Final Score						

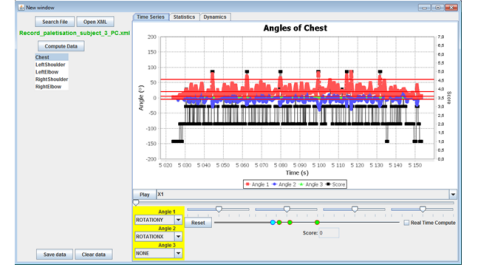
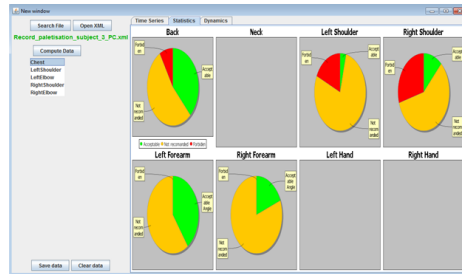
Use of statistics for complementary penibility assessment

- Several statistics can be computed for a better intervention decision
 - Ration of time in each position category
 - Average category transition rate

Example: Chips conditioning

Nodes deployed on:

- Arms
- Forearms
- Chest



Perspectives

Use of machine learning method

With a massively deployed system it is possible to record enough data to use machine learning method. Adding individual characteristics data shall help to make reliable prediction for each profile. Currently there is no database available to apply machine learning methods.

Applying the system to functional rehabilitation

Body area network allows distant monitoring without camera. This can also be used as a self-rehabilitation tool using gamification.