WBAN Application For Estimation of Occupational Disease Risk By Measurement of Postures

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***Abstract*—MusculoSkeletal Disorders (MSD) caused by working conditions are a concerning issue of our society. In France, MSD represent 45000 people counted as occupational disease declared in 2014. MSD are mainly caused by three factors: (1) Bad postures (2) Muscle tension caused by an intense effort or prolonged static postures. (3) Repeated motion like in work at the chain. We present our system called Zyggie which is a Wireless Body Area Network (WBAN) which here is used to estimate MSD risk. The system we propose uses Zyggie sensors on the body of an operator. An Android application provides a user interface which allows to calibrate the system and monitor results in real-time.**

I. Introduction

Zyggie is the node of the BoWI project [1] Wireless Body Area Network (WBAN) (see Figure 1), uses inertial sensors which data are used to estimate the posture of the operator. The android application developed for tablet (see Figure 2) processes and store data from Zyggie. The posture estimated can be considered with an ergonomic point of view using methods like the Rapid Upper Limb Assessment (RULA) [2]. This method is commonly used for its accessibility for non ergonomist expert users. RULA allows to make a quick assessment on a working risk level with a scoring method based on anatomic angles considerations. The goal of RULA is to detect situation with potential risk for MSD in order to initiate further accurate studies if needed.

II. Zyggie

Zyggie is a prototype that contain

- A $EFM32WG330F$ the main micro-controller.
- Classic inertial sensors, accelerometer, gyrometer and magnetometer.
- A 802.15.4 compatible radio transceiver.
- UWB radio for distances estimation.
- 300 mAh Li-po Supply.

Communication between nodes is guaranteed by a custom protocol based on the 802.15.4 stack. The topology is a nested-mesh with one coordinator. The coordinator can be connected by USB to a PC or tablet and act as the gateway of the network.

III. Tablet Application

The application is developed for Android and is compatible with most of recent Android tablet. The application provides a user interface to connect and configure network parameters. Several usages have been developed, one of them is the real-time posture estimation.

The system has to be calibrated to the current operator in order to be functional. Nodes must be correctly associated to part of the body and some specific gestures have to be performed to initialize the system. A feedback of the real-time 3D posture estimation is also given.

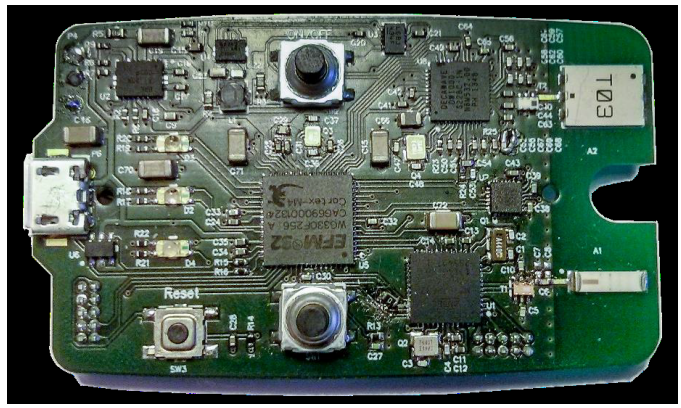

Figure 1: Zyggie board

Figure 2: User Interface of Android application

Then, using RULA method with the estimated posture, the score of the current posture is computed which gives an assessment on the risk of MSD of the operator. This system can be deployed on real workplace to measure MSD risk on real case. Results can also be stored for potential posterior analysis and can be replayed to visualize the posture.

References

[1] "Bowi poroject," http://www.bowi.cominlabs.ueb.eu/fr.
[2] L. McAtamney and E. N. Corlett, "Rula: a survey method for the investigation of work-related upper limb disorders," *Applied ergonomics*, vol. 24, no. 2, pp. 91–99, 1993.