J. Parera, C. Angulo, J. Cabestany. ZigBee communication when building a body sensor network. Gerontechnology 2008; 7(2):183. Usually, more than one inertial measurement unit (IMU), built on accelerometers and gyroscopes, MEMS (microelectromechanical systems) type sensors, is needed to measure human posture and activity in elderly people, several nodes being placed on different body parts. ZigBee communication is analyzed in this work as a useful wireless protocol when a body sensor network that measures human movement is being designed. Moreover both, processing and analysis of the captured signals will be made online on a particular IMU-based node, in order to obtain online biofeedback from the network, so a method to gather information from several nodes is needed. ZigBee is the wireless communication standard selected because its low power consumption, low data rate, ability of operating in different topologies, network robustness and range. Experiments shown that a good balance between precision, power consumption, data transmission bandwidth and number of nodes is obtained when the sampling rate to monitor human activity is about 60 tri-axial/tri-axial+w readings per second in each sensor node. Since data processing uses data coming from several IMUs in the same calculation and ZigBee doesn't implement a networked time synchronization between the nodes of a network, data must be enlarged with a field providing the time when the measure was taken from the sensor. The body sensor network is based on a star configuration to save energy and maximize bandwidth: a master node is always 'on', meanwhile some sensing nodes (up to 9) can turn off its radio and microprocessor in order to save battery life, increasing its autonomy and/or using smaller size batteries. Each sensor node reads data from the MEMS devices, then it sleeps while waiting to the next period of measure. Once the amount of data is enough to fill a ZigBee message it sends the data to the coordinator node. Two kinds of sensor nodes have been implemented: (i) *DSPic-based sensor node*. It consists of an EM250 radio communication module (RCM), a DSPic board containing, two biaxial analog accelerometer sensors and one analog gyroscope. The DSPic converts the analog data from the sensors to digital data then performs a low pass digital IIR filter and finally sends the data to the RCM through a UART interface. (ii) *SPI based sensor nodes*. They consist of an EM250 RCM and tri-axial accelerometer module with SPI interface (*Figure 1*). The RCM uses its own microprocessor to gather data from a SPI ADC converter; in this way the power consumption is reduced but has less processing capabilities than de DSPic version. The data gathered by the coordinator node are sent to a PC that reads, process and stores it trough the UART port, but this source of data can be processed online by powerful a processor, like a PDA or a DSPic.

References

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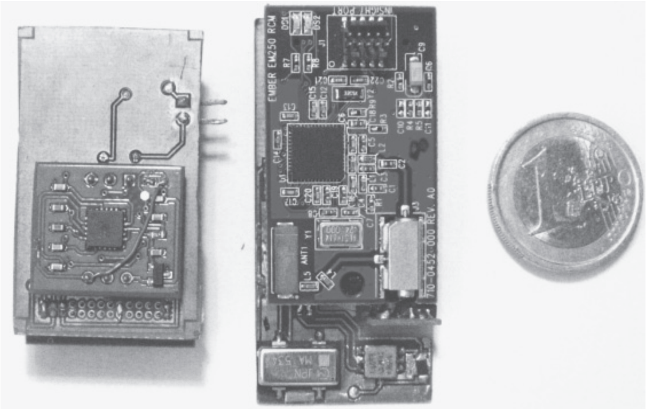

Figure 1 Size of a tri-axial accelerometer (left) on the back of a ZigBee RCM (middle), and a 1 Euro piece for size comparison (right)