Bio-signal device prototype 2

February 25, 2009

1 Design

1.1 Architecture

Figure 1 gives the overal structure of a physiological measurement device. Figure 2 proposes the integrated solution decided for the SUM project. The CUI board has been selected for hosting the interface and the dedicated electronics.

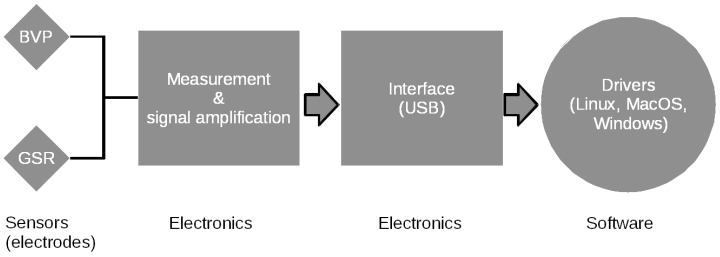

Figure 1: Components of a biosignal sensing device

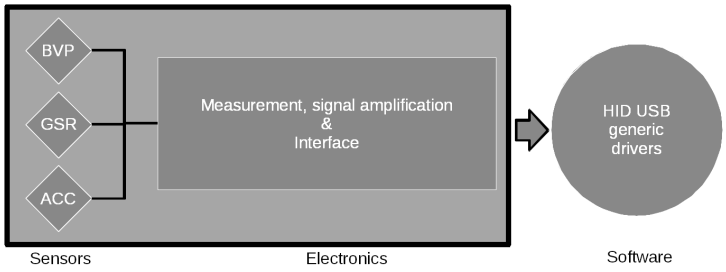

Figure 2: Design of our biosignal recorder

The Galvanic Skin Response (GSR) sensor uses two electrodes in contact with the skin surface on two fingers extremities. The Blood Volume Pressure (BVP) sensor uses an infrared LED and a photosensor to measure the variations of IR reflections when the blood flows into the extremity of a finger. A detailed schematic of the electronics for measurement and amplification of these two signals will be given by Hans-Ole.

In addition, a 3 axis accelerometer will be integrated. FourMs laboratory has experience with this.

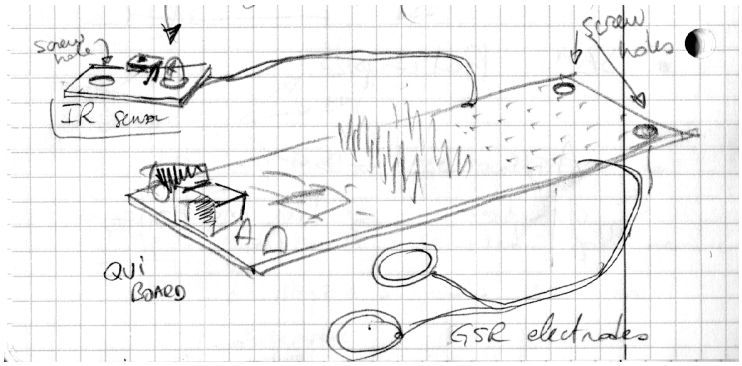

Figure 3: Sketch of the electronic parts of the biosignal measurement device.

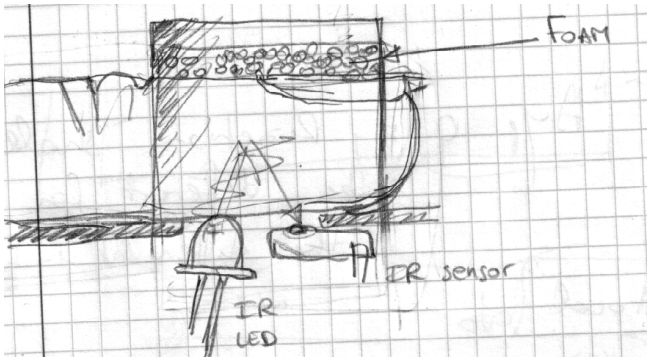

Figure 4: Sketch of BVP measurement on finger extremity: sensors placement and finger covering.

An overview of technologies for sensor interfaces is given at sensor wiki `http://sensorwiki.org/doku.php/interfaces/introduction`.

1.2 Integration

The final device will contain this board; it will be fixed inside the shell by blocking it on one side (the "plug side") and skrewing the other end (see skrew holes in figure 3).

The GSR electrodes should be mounted on the device, and therefore two wires shall connect them to the board.

The BVP sensor shall be mounted on a little board ("IR sensor" in figure 3) which has a hole for being later skrewed inside the device. The IR LED and photosensor are mounted on the device in order to touch the skin of the middle finger through a hole in the shell. To ensure a correct placement of the finger, and maximum immobility, the finger shall "fit into" the device nicely and eventually be gently compressed by a bit of foam (see figure 4).

Little plugs on the board to connect the GSR and BVP sensors could help in the mounting and maintenance of the device.

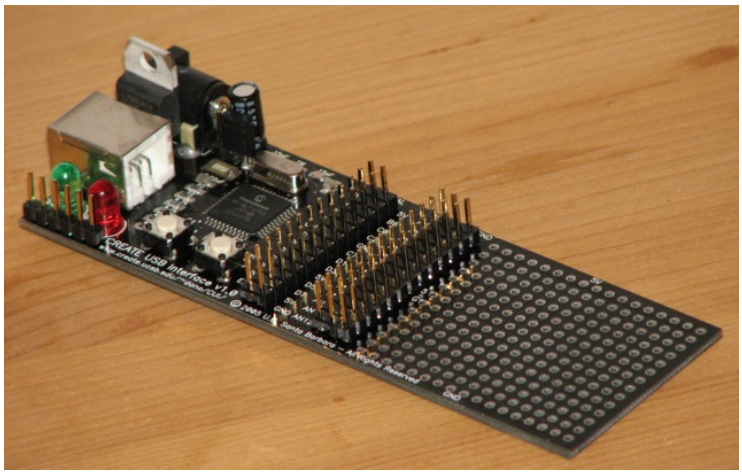

Figure 5: The CUI board (http://www.create.ucsb.edu/~dano/CUI/)

2 Specifications

2.1 Interface

CREATE USB Interface (figure 5).

- CUI web site: `http://www.create.ucsb.edu/~dano/CUI`
- Programmable microcrontroller : PIC18F4550 (in C)
- 12 analog inputs
- Existing MaxMSP patch.
- HOW TO BUY: email to dano@create.ucsb.edu, use paypal.

2.2 GSR and BVP sensors

The first prototype allowed to validate the electronics for the measurement of GSR and BVP. Figure 6 shows the shematic for it. For the second prototype, the electronics will be pretty much the same.

- HOW TO BUY: Hans-Ole is ordering the components.

2.3 Accelerometer

ADXL 330 (or 335): 3-axis accelerometer (figure 7)

- Outputs an analog voltage for each of the three axis. This voltage is in ratio to the measured acceleration and to the supply voltage (ratiometric)
- Speficication: `http://www.analog.com/en/mems-and-sensors/imems-accelerometers/adxl330/products/product.html`
- HOW TO BUY: Online from SparksFun product: `http://www.sparkfun.com/commerce/product_info.php?products_id=692`

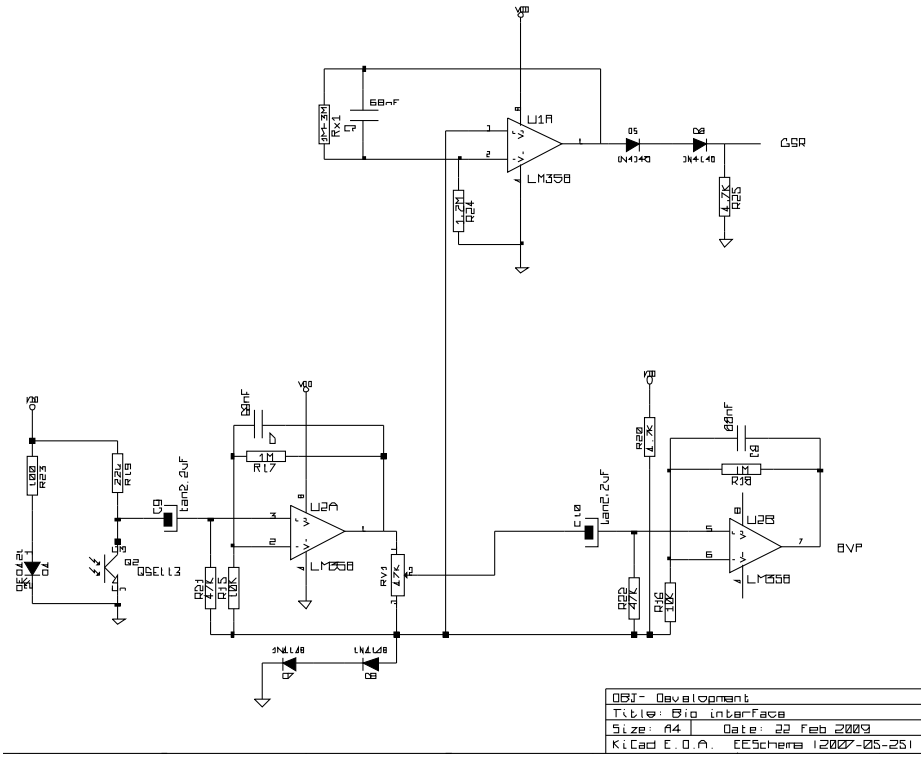

Figure 6: Schematic of GSR and BVP electronics in prototype 1.

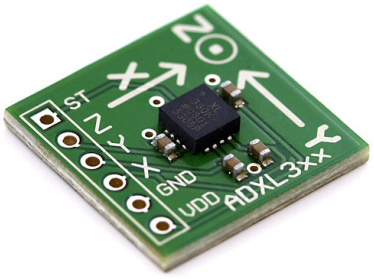

Figure 7: 3 Axis accelerometer.

3 Development plan

Deadline	What	Who
17 Feb	Document “Bio-signal device prototype 2” released.	Bruno
20 Feb	Ordering (online) of the components to build 5 sensors (5x CUI, 5x accel, etc.)	Lars, Hans-Ole
1 Mars	4Ms laboratory recieves 2 IR sensors (see sec.1.2) and two sets of GSR electrodes.	Hans-Ole, Bruno
1 Mars	Hans-Ole is given a document explaining how to solder the accelerometer on the CUI board.	Alexander
2 April	Hans-Ole delivers (to Bruno) two CUI boards with integrated electronics for sensors.	Hans-Ole
4 April	Bruno brings the 2 CUI boards to ESBJERG meeting.	Bruno
4 April	4Ms brings 2 3D-printed shapes (already integrating the sensors) to ESBJERG meeting.	Alexander
17 April	Last deadline for delivering 2 complete prototypes to Bruno (in case assembly on April 4th needed re-eingineering)	Alexander, Hans-Ole
20 April	Phase 1 experiment in AAU Ballerup.	Bruno
23 April	Phase 2 experiment in AAU Ballerup.	Bruno