

## **JSI - Cardio & Brain Signals - Signal conditioning system for physiological signals**

The Cardio & Brain Signals – a Signal conditioning system for physiological signals was developed by joint effort of several research institutions under the 6<sup>th</sup> framework project BRACCIA. The development team was funded by the EU and Slovenian research and development agency with the main goal to design and develop a new system for data acquisition easy-to-use and operate. The system was successfully used for a number of measurements on humans and rats during anesthesia under the project BRACCIA and by other research institutions for their specific use more specifically the Faculty of Arts at the University of Ljubljana.

The Cardio & Brain Signals is a 12-channel signal conditioning and acquisition system, specially designed for the purpose of measuring and observation of the causality of interactions between the natural biophysical oscillations during general anesthesia. The device technical design is based upon high-end A/D conversion. The obtained digital signals are preprocessed by a soft-core processor and sent via USB to a standard PC equipped with custom software for additional data processing, monitoring and storage. The fact that the signals are preprocessed by an embedded system makes it very easy to use.

The device was designed to target hospitals and various research institutions as primary customers/users. With new publications in international journals from studies performed with the Cardio & Brain Signals, the device has proven to be useful in different areas than it was designed for, and it has been internationally recognized. Its hardware could be used in different scenarios by simply modifying the acquisition software running on standard PC. Additionally, the system is easy to use by personnel with different professional backgrounds, mostly medical staff. As the device was designed with simple housing with no buttons, the operator must only attach the sensors and connect the device to the PC with single USB cable and start the software to begin recording. Additionally, the device could be powered via mains power supply or in case of bad signal quality with battery.

The project received an important feedback from a large set of measurements performed at three research institutions during the project BRACCIA. The device and the accompanying software went through several iterations where the hardware and software were upgraded to improve performance and eliminate any possible errors. Besides that, several journal papers were published from data recorded with the Cardio & Brain Signals.

<http://dsc.ijs.si/en/>

### **SWOT ANALYSIS**

#### **Strengths:**

- The device implements high standards for medical safety;
- Flexible device. The hardware can be used in different scenarios by simply modifying the acquisition software running on standard PC;
- The device can operate in electrically polluted environments efficiently;

- New algorithms for the analysis of complex cardiovascular and neural signals were developed, which enable improvement the understanding of the process of anesthesia;
- The transnational research team ensured synergy of ideas;
- Private initiative followed the initial public funding of the project;
- Ideas from different professional backgrounds were include in the specifications of the device. Therefore, the area of interest was covered properly by different experts.

### **Weaknesses:**

- No list for potential customers;
- No plan for future financing of future production;
- Lack of comparison with similar devices;
- The operators experience difficulties when performing measurements. The main source of these difficulties is that the wires are in impractical in certain measurement setups;
- The device has not reached the market;
- There is no market experts involved directly in the project.

### **Opportunities:**

- The system shows wide prospects in terms of applicability due to the universal nature of the approach;
- The system can be combined with additional hardware to serve as a prototype to test new medical applications, which have the potential to improve the quality of service in medical institutions;
- The device can be used in different fields of medicine either as purely experimental device or as commercial device targeting specific needs;
- New medical products and systems could be developed on the base of created device.

### **Threats:**

- Insufficient financial founds for opportunities realization;
- It is not possible to perform the expected technological enhancements;
- Without considerable marketing and promotion efforts the results of the BP can never be transformed into a product.