

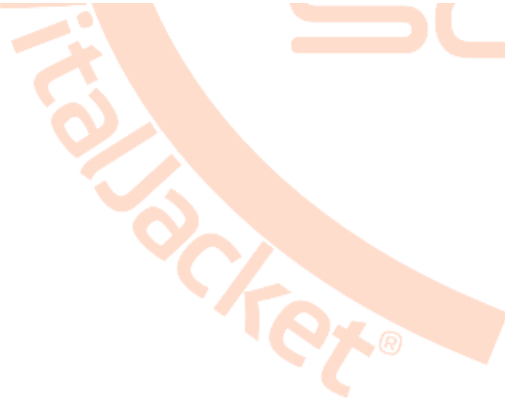


VitalJacket® SDK





VitalJacket SDK v1.0.07 – Technical Specifications

LEGAL NOTICE AND DISCLAIMER

ATTENTION: Although VitalJacket is a certified medical device, its developer version is NOT certified for diagnosis usage. It is intended for R&D and development purposes only. Users of VJ SDK can submit their final developments to medical certification. All contents of our product are compliant with the European Medical Device directive 93/42/EEC but, being a developer's version, it's not certified.

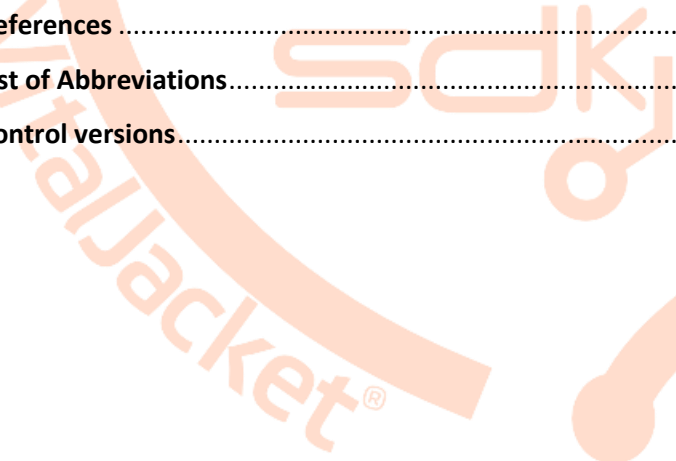


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Introduction

VitalJacket[®] is a wearable system with real time ECG acquisition that can be transmitted on-line or stored for posterior analyses. The ECG signal is send in real time to an online module using Bluetooth (wireless) or stored in a memory card. This data can be accessed through VitalJacket SDK package.



VitalJacket SDK

Objectives

Offer new VitalJacket integration possibilities into R&D projects, new prototypes and products.

Provide developers a Software Development Kit (SDK) and API for different programming environments with drivers and sample code.

Allow VitalJacket configuration through a simple messaging protocol/Mode switching to enhance its adaptability.

What is VitalJacket SDK?

A tool to provide all stream control parameters (Sampling Frequency, Gain, etc.), Mode Switching (Configuration/ Recording); RTC settings; Pushbutton event (on Bluetooth stream and SD Card)

- App Windows for test and data acquisition;
- App Android
- Tools for data export: full ECG wave (1-5 leads), beat-by-beat R-R (ms), QRS position (sample offset), Tri-axial accelerometer (X,Y,Z; +/-4g);
- Windows DLL for QRS detect (Pam & Tompkins, MIT-BIH database validated);
- Linux library (64bits) with QRS detect;

Why should we use VitalJacket SDK?

For VitalJacket integration in your R&D projects, new biosignal prototypes and products.

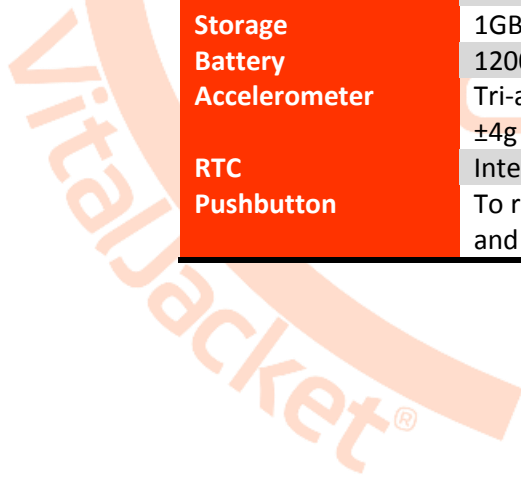
To provide developers a new Software Development Kit and API for different programming environments with drivers and sample code.

To allow VitalJacket configuration through a simple messaging protocol. Mode switching to enhance its adaptability.

Hardware Technical Data

Technical Specification	
Current	40 mA/h
Gain	500
Max Signal Range	3.3 mV
Power	132 mW/h
Leads	Full ECG data output at 500Hz, Version 1L: Lead I Version 5L: Lead I, Lead II, Lead V1 – V3, Lead V4 – V6 Lead III can be computed after sampling
Temperature	-20°C to +45°C
Dimensions	66 x 38 x 16 mm
Weight	50g
Battery Autonomy	72hours

Logger Unit Specification	
Communication	Bluetooth 2.0, Class 2, 2.4GHz
Storage	1GB SD Card
Battery	1200mAh rechargeable Li-ion
Accelerometer	Tri-axial accelerometer output at 10Hz, ±4g
RTC	Integrated in device
Pushbutton	To register events (in Bluetooth stream and SD Card)



Software applications

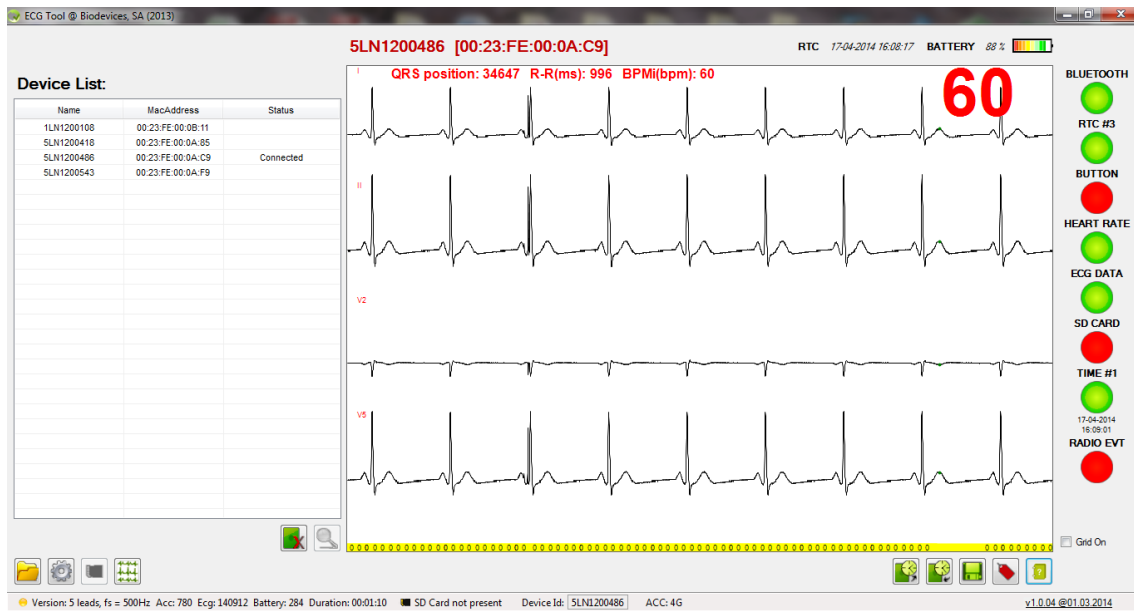
Support Application
ECGTool for Windows
Windows DLLs for data processing
Sample code C# .Net for development
Library Android for data processing
Sample code in Android
Tools for export data to Matlab: InfoExporter, ECGParser
Library Linux for data processing



- App Windows for test and data acquisition – **ECGTools.exe**;
 - Set and Get RTC timecode;
 - Set radio-event in ECG data (device write this event in SD Card of device);
 - Beat-by-beat R-R (ms) and QRS position (samples offset);
 - Get device ID;

Win	ECGTool.exe	
	Search devices VJ	
	Connect to device VJ	
	Acquisition data from device VJ	Full ECG data
		Acc data
		Battery level
		RTC timecode
		Pushbutton event
		Timestamp
		SD Card status
	Record data to open in VJ Reader 2.0	
	Send radio event to device	
	Get device ID from device	
	Get accelerometer sensibility	
	Configure SD Card tool	
	Convert ECG raw data to binary format	
	Export R-R data	

App windows for test devices

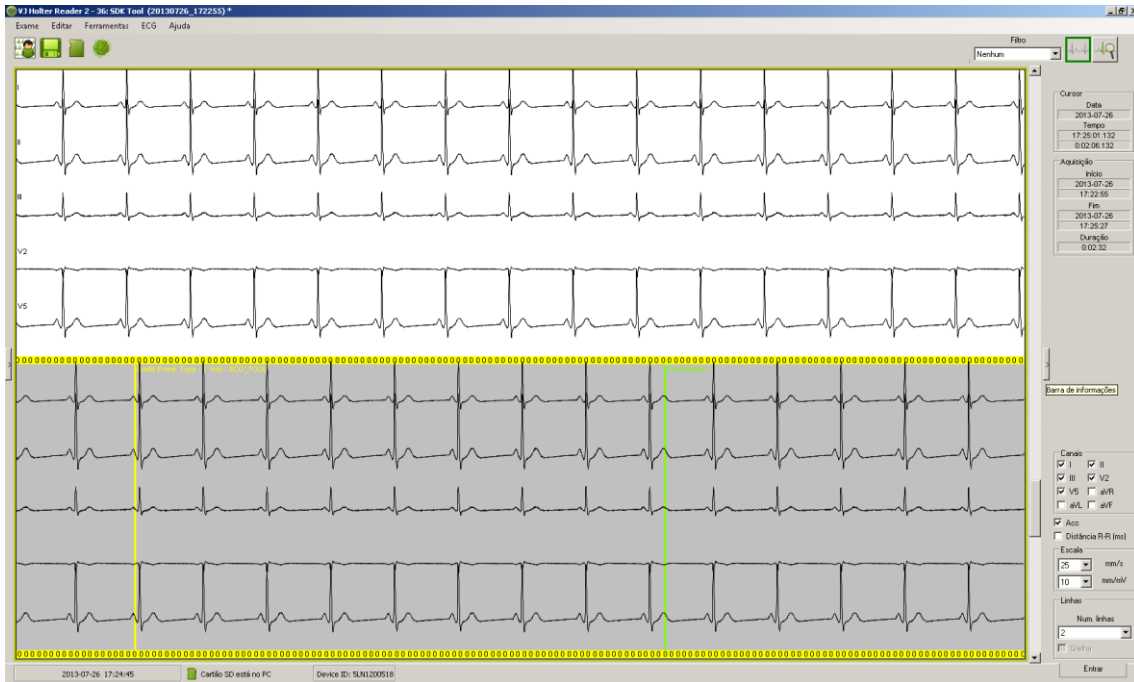


- Windows DLL for QRS detect (**QrsDetector.dll**) – the QRS detector is based on the algorithm of Pan and Tompkins [1] and was used MIT-BIH database to validate results [2];
- Windows DLL for data processing (**BioLib.dll**) with QRS detector [1];

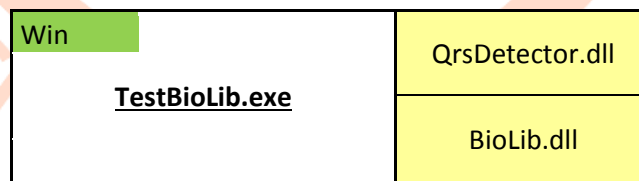
BioLib.dll	ECG stream
	Accelerometer data
	Battery level
	RTC time code
	Pushbutton event
	Timestamp
	Accelerometer sensibility
	SD Card status

Parser to extract data received from device

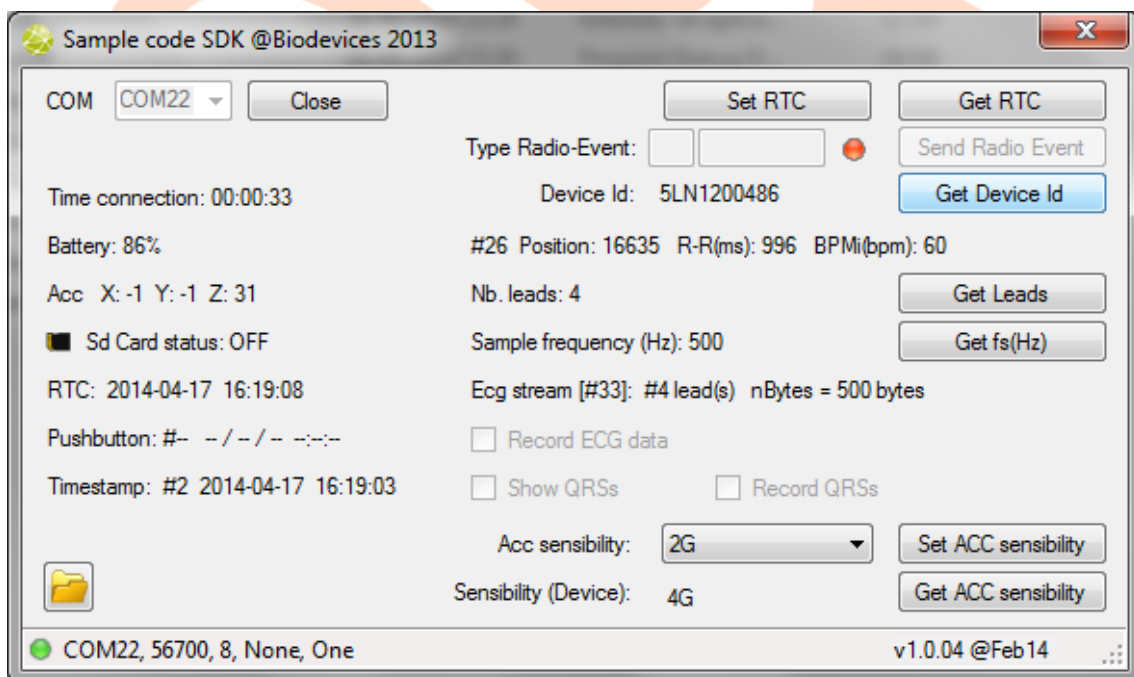
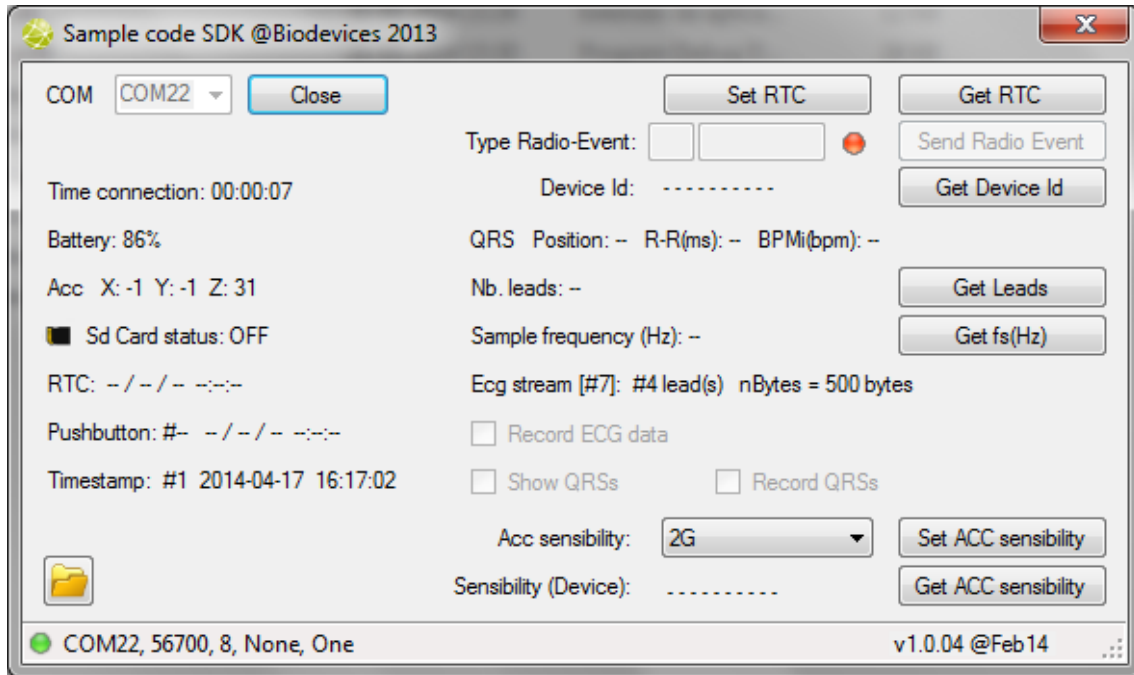
- The exams can be opened in **VJ Reader 2.1** software (available for download from http://www.vitaljacket.com/?page_ID=200):



- Windows sample code for easy integration of the **BioLib.dll** and **QrsDetector.dll** (**TestBioLib project**, in Visual Studio 2010, .Net Framework 4.0);



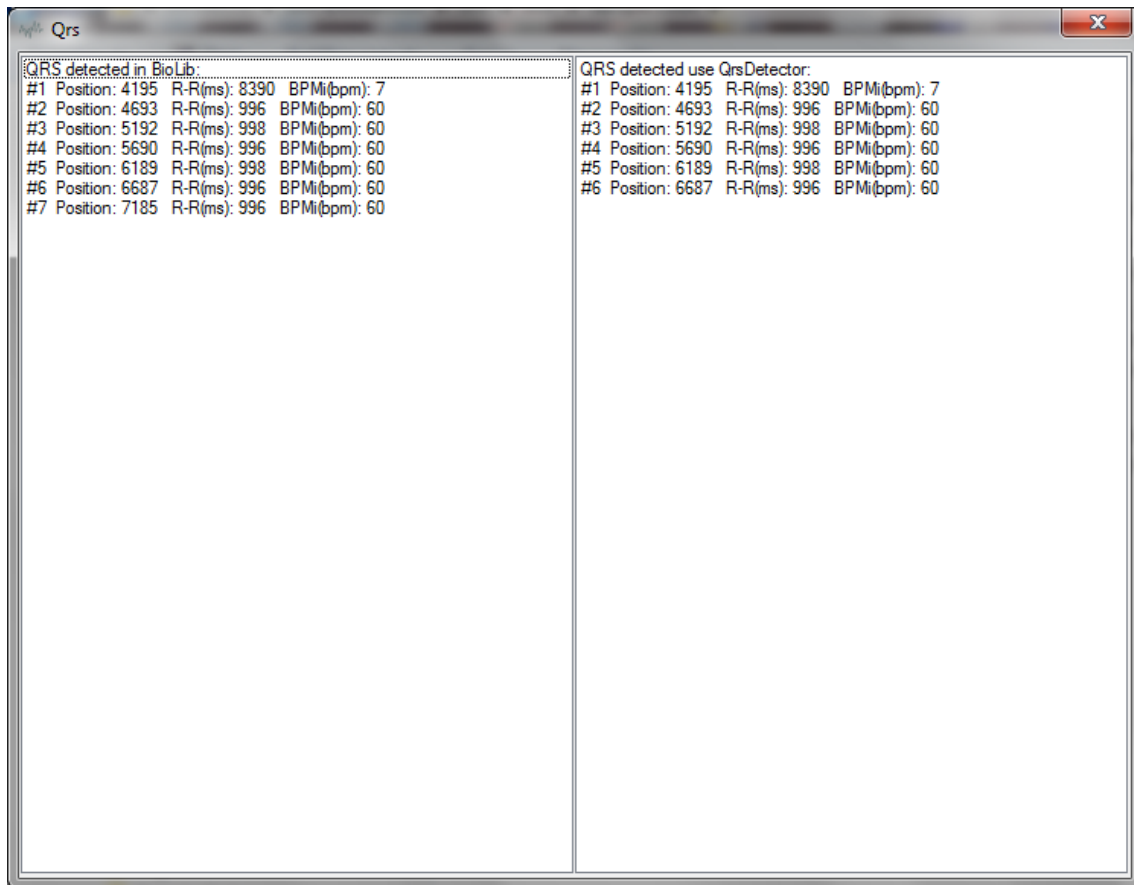
Sample code for use BioLib.dll and QrsDetector.dll



Samples code for:

- Get device ID from device (Serial Number from device VitalJacket);
- Send radio event to device with info data (10 bytes maximum) – register in SD Card;
- Get / Set RTC time code;
- Get / Set accelerometer sensibility in device VitalJacket;

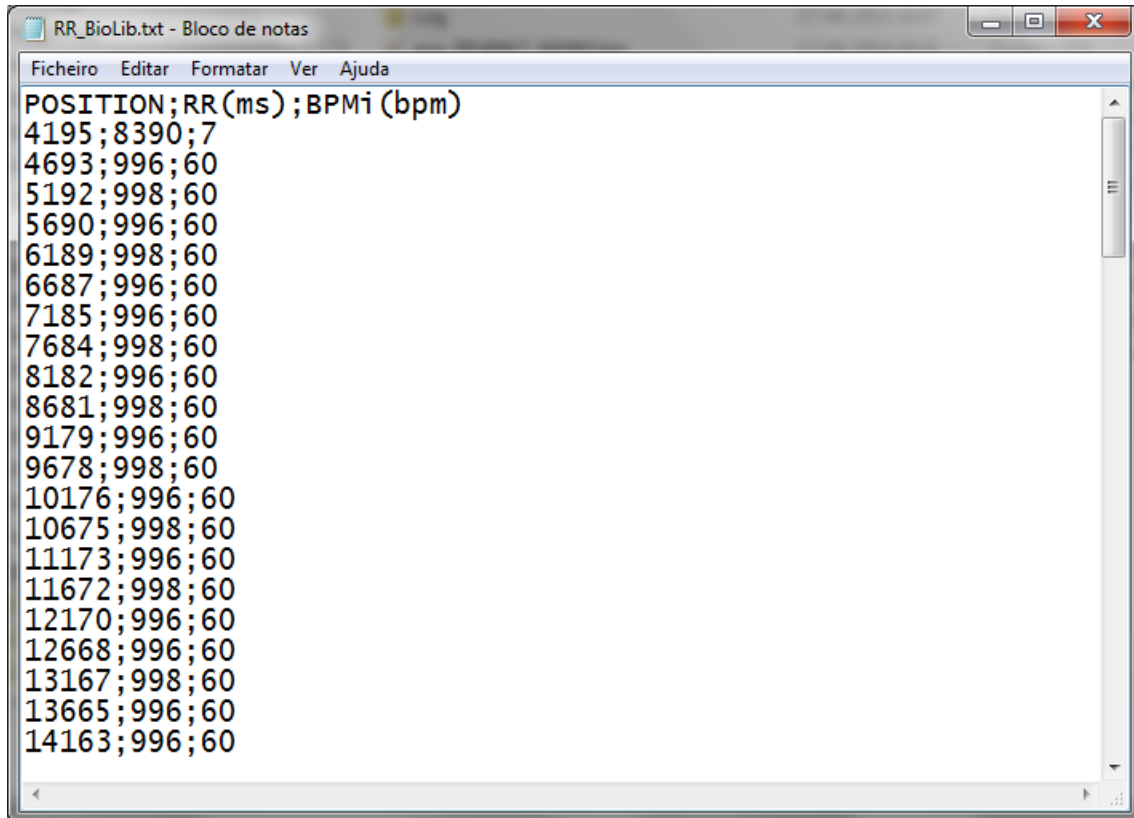
View QRS complexes (*Show QRSs* checkbox).



It's possible save QRS complexes (*Record QRSs* checkbox).

Format R-R file:

- Sample offset;
- R-R (in ms);
- Pulse (in bpm);



```

RR_BioLib.txt - Bloco de notas
Ficheiro Editar Formatar Ver Ajuda
POSITION;RR (ms);BPMi (bpm)
4195;8390;7
4693;996;60
5192;998;60
5690;996;60
6189;998;60
6687;996;60
7185;996;60
7684;998;60
8182;996;60
8681;998;60
9179;996;60
9678;998;60
10176;996;60
10675;998;60
11173;996;60
11672;998;60
12170;996;60
12668;996;60
13167;998;60
13665;996;60
14163;996;60
  
```

A log file is generated in the directory 'C:\VJ_SDK\'. The log file's name is generated with the program name with the current date. The log file has .txt extension and one log file is created each day. If there is a problem the log file must be edited to analyse problems and the log file must be send to the technical support team (support@biodevices.pt) with a description of the error.

```
Log_17042014.txt - Bloco de notas
Ficheiro Editar Formatar Ver Ajuda
#####
# LOG FILE SDK #
# VERSION: 1.0.03 #
#####

Date          2014-04-17  16:07:09.685
UserName      Nuno
MachineName   DUBLIN
UserDomainName DUBLIN

17-04-2014 16:08:13: BT: call connect ::><
17-04-2014 16:08:13: BT: wait connect ::><
17-04-2014 16:08:14: BT: wait connect ::><
17-04-2014 16:08:14: BT: wait connect ::><
17-04-2014 16:08:15: BT: wait connect ::><
17-04-2014 16:08:15: BT: wait connect ::><
17-04-2014 16:08:15: BT: OnConnect get ok ::
17-04-2014 16:08:16: BT: wait connect ::>ok<
17-04-2014 16:08:16: BT: after wait connect ::>ok<False
17-04-2014 16:12:55: BT: disconnect ::
17-04-2014 16:12:55: BT: onDisconnect event
```





- Android library for data processing (**BioLib.jar**) with QRS detector [1];

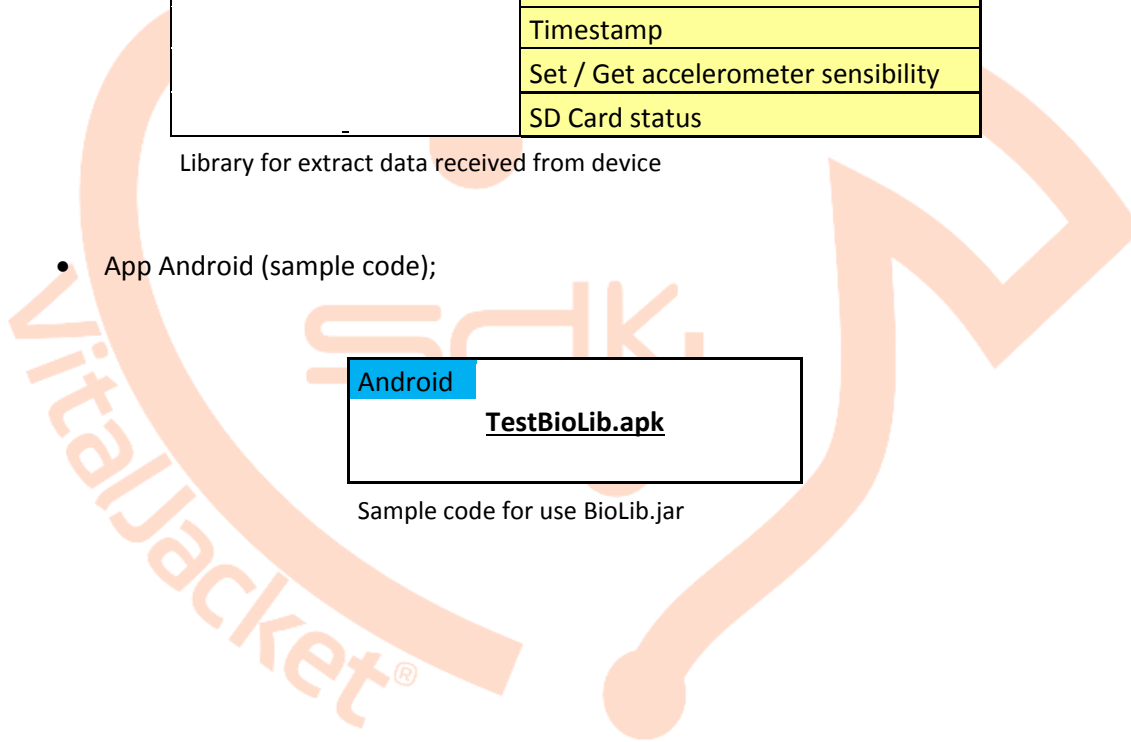
BioLib.jar	Full ECG stream
	Tri-axial accelerometer (X,Y,Z) data
	Battery level
	RTC time code
	Pushbutton event
	Radio event
	Device ID
	Timestamp
	Set / Get accelerometer sensibility
	SD Card status

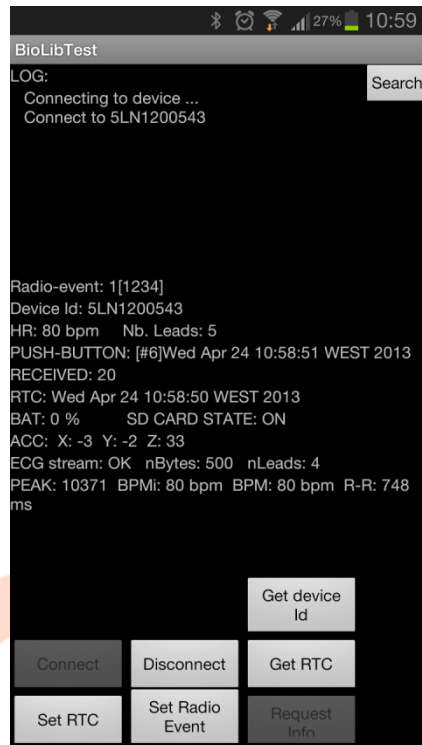
Library for extract data received from device

- App Android (sample code);

TestBioLib.apk

Sample code for use BioLib.jar



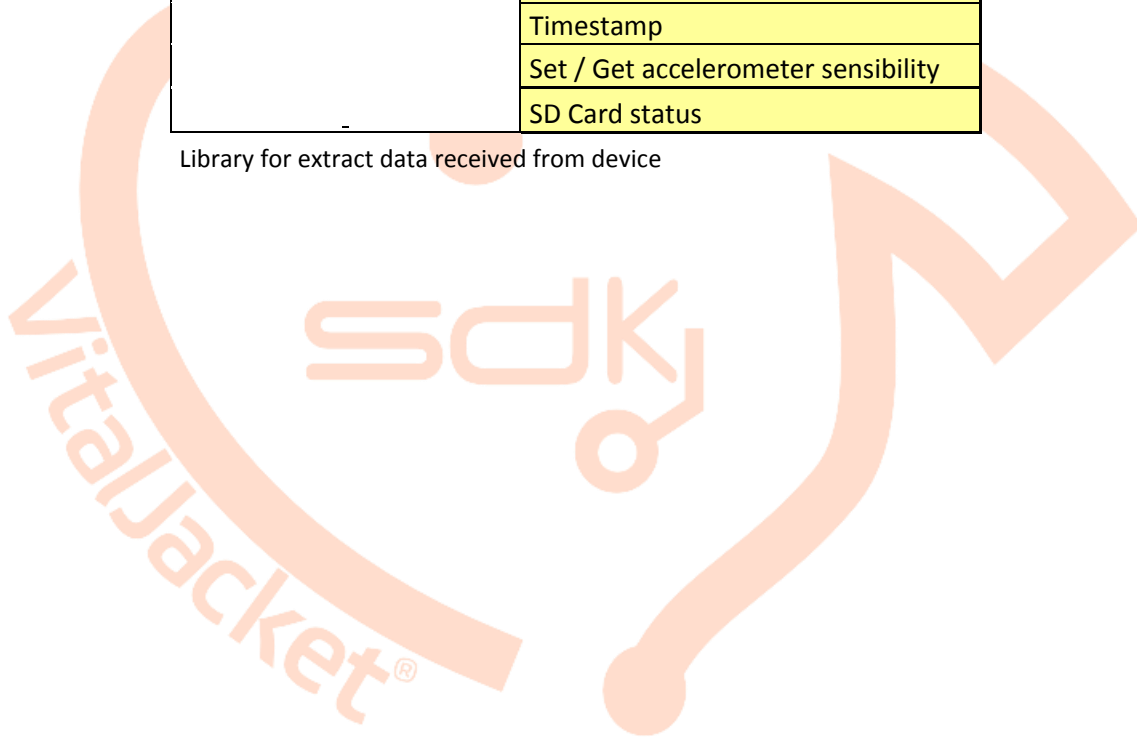




- Linux library (64bits) for data processing (**BioLib.a**) with QRS detector [1];

Linux	Full ECG stream
BioLib.a	Tri-axial accelerometer (X,Y,Z) data
	Battery level
	RTC time code
	Pushbutton event
	Radio event
	Device ID
	Timestamp
	Set / Get accelerometer sensibility
	SD Card status

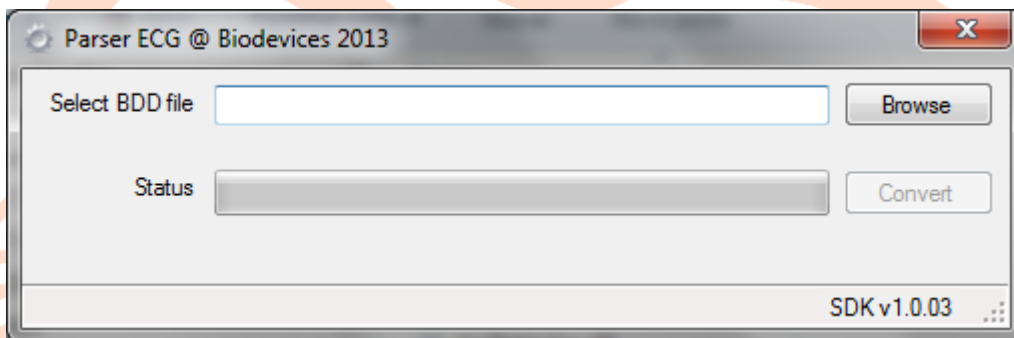
Library for extract data received from device



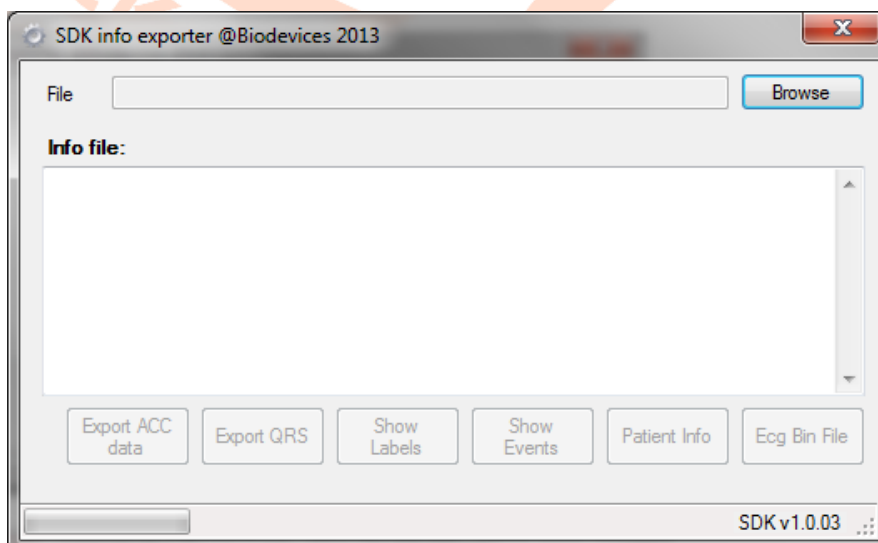


The SDK includes a verified .m scripts to load the data files created to be loaded directly into Matlab.

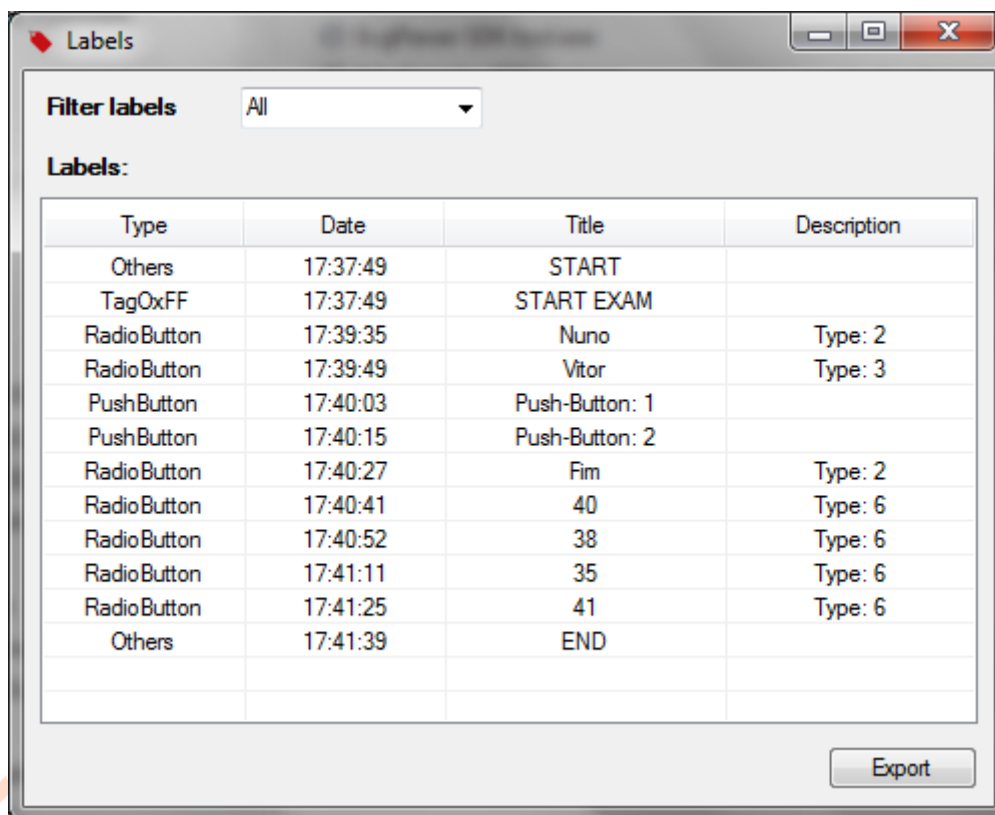
- Tools for data export:
 - Full ECG data, beat-by-beat R-R (ms);
 - QRS position (samples offset);
 - Tri-axial accelerometer (X,Y,Z);
 - App *ECGParser.exe* convert ECG raw data file in binary format.



- App InfoExporter.exe to export exam data (ECG, labels, QRS) to open in Matlab, Excel:



This tool allows to export labels in exam to txt file for use in Matlab or Excel:



If exam has analysed QRS, it is also possible to export QRS data for txt file.

	A	B	C	Barra de fórmulas	F
1	Position [samples offset]	Type	R-R (ms)	HR (Bpm)	
2		5139 NORMAL	998	60	
3		5638 NORMAL	998	60	
4		6137 NORMAL	998	60	
5		6635 NORMAL	996	60	
6		7134 NORMAL	998	60	
7		7633 NORMAL	998	60	
8		8132 NORMAL	998	60	
9		8630 NORMAL	996	60	
10		9129 NORMAL	998	60	
11		9629 NORMAL	1000	60	
12		10127 NORMAL	996	60	
13		10627 NORMAL	1000	60	
14		11125 NORMAL	996	60	
15		11624 NORMAL	998	60	
16		12123 NORMAL	998	60	
17		12622 NORMAL	998	60	
18		13120 NORMAL	996	60	
19		13619 NORMAL	998	60	
20		14118 NORMAL	998	60	
21		14616 NORMAL	996	60	
22		15115 NORMAL	998	60	

References

[1] Pan J and Tompkins WJ. A Real-Time QRS Detection Algorithm. IEEE Transactions on Biomedical Engineering 32(3):230-236, 1985

[2] MIT-BIH Arrhythmia Database: <http://www.physionet.org/physiobank/database/mitdb/>



List of Abbreviations

SDK – Software Development Kit

ECG – Electrocardiogram

API – Application Programming Interface

RTC – Real Time Clock

ID – Identification

VJ – VitalJacket

Acc – Accelerometer



Control versions

Version	Date	Change log
1.0.02	30-04-2013	<i>Get device ID</i>
		<i>Send radio event to device</i>
1.0.03	19-07-2013	<i>New method to send radio-event to device</i>
		<i>A new too (InfoExporter.exe) for export data to Excel and Matlab</i>
1.0.04	01-05-2014	<i>Set and Get accelerometer sensibility in device VitalJacket</i>
1.0.07	06-03-2015	<i>Library for Linux for processing data</i>

