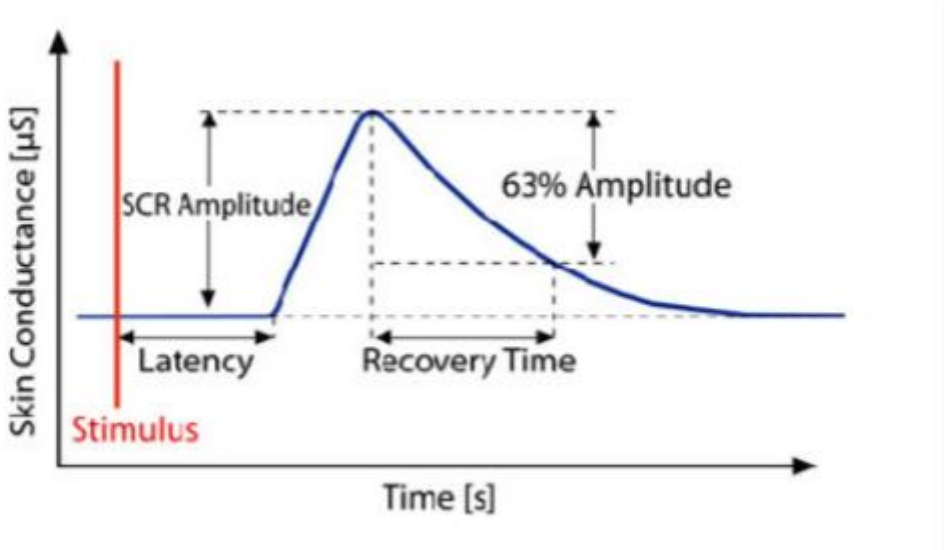
User Manual of the application

Daniel Marchán Diego López Marvin Fernández Levian Gonzalez

An arrhythmia is an abnormality of the heart´s rhythm. This heart disease alters the heart rate (tachycardia increases heart rate, while bradycardia decreases it). Normally the patient suffers symptoms such as dizziness, fainting, palpitations and breathlessness. However, some patients have no symptoms, so electrical detection will be measured by Electrocardiography (ECG) and Electrodermal Activity (EDA), facilitating the doctor´s diagnosis.

We use these tests since there is a correlation between heart rate, respiratory rate and skin electrodermal responses.

EDA Sensor Data Sheet allows us to measure the skin´s electrodermal responses also called Skin Conductance Response (SCR). It acts by measuring the effects mediated by nerves on the permeability of the sweet glands. These effects produce differences between the electrical potential at different parts of the skin. For instance, a decrease in skin conductance is related to an increase in respiratory sinus arrhythmia.



The peaks in the signal in the figure are the Skin conductance responses (SCR), they occur in reaction to individual stimuli, as warning events. The SCR can be described through its breadth, latency and recovery time. Sweating is the mechanism that the body uses to cool down. The nervous system automatically activates the sweat glands when body temperature rises. This abnormal sweating or hyperhidrosis indicates a hyperactivity of the autonomic nervous system which regulates heart rate.

SCR allowing us to detect stress that together with the ECG increases the diagnostic accuracy.

To apply what is described mathematically, the EDA sensor of the bitalino needs the following processes:

First the transfer function resistance in mega Ohms is calculated.

$$R_{MOhm} = 1 - \frac{ADC}{2^n}$$

ADC is the value sampled from the channel and the number of bits of the channel.

With the resistance value, the sensor obtains the EDA value in micro-siemens (Us).

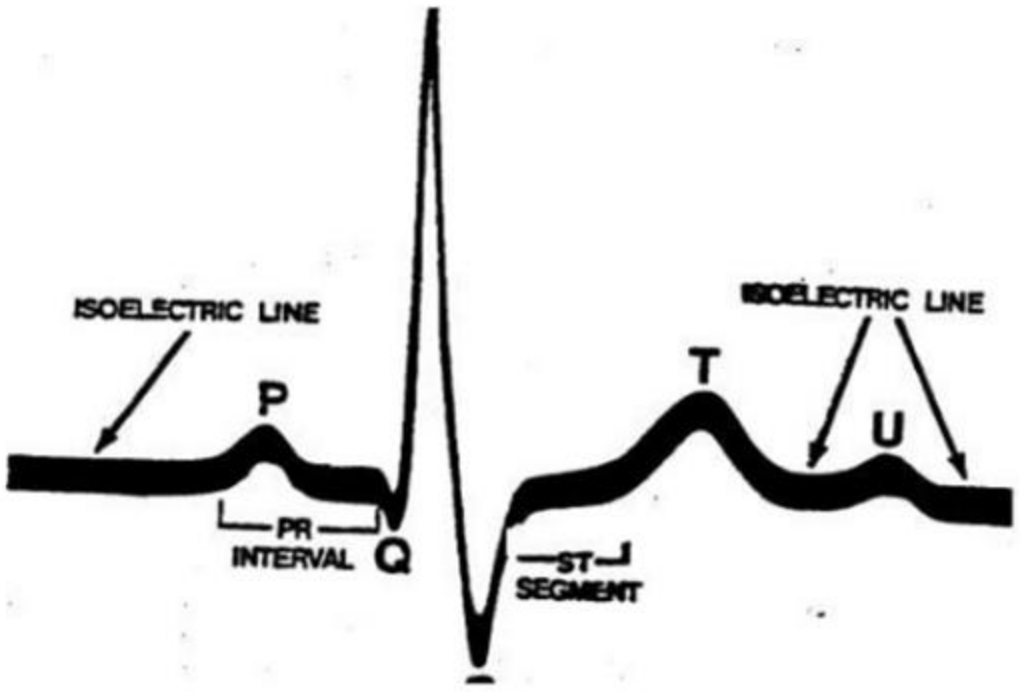
$$EDA(uS) = \frac{1}{R_{MOhm}}$$

The noise removal is needed to clarify the signal, α = 0.05(smoothing factor (0<α<1)) was used to remove high frequency noise, where x is the contribution of new input data, and (1−α)*F adds inertia from previous data.

$$F_t = \alpha x_t + (1 - \alpha) F_{t-1}$$

Bitalino software sends raw signals produced by the analogical to digital converter. Then the program is responsible for storing and sending the received payload data.

Electrocardiography (ECG) Sensor Data Sheet analyses the heart and respiratory allowing us to calculate the number of complexes QRS. An arrhythmia is a disruption of the conduction system. This system makes up the PQRST complex, QRS represents the ventricles depolarizing collectively, and it is the origin of all ventricular rhythms. Has an inherent rate of 20-40 beats per minute.



ECG allows the recognition of P, its frequency, morphology and relationship with the complex QRS. Identifying if the heart rate is normal or the specific type of arrhythmia.

Mathematically the ECG sensor in BITalino were converted to standard units of measure:

$$ECG_{mV} = \frac{(ECG_B \times \frac{Vcc}{2^n} - \frac{Vcc}{2})}{G_{ECG}} \times 1000$$

Where the ECG value is in millivolts, the ECGB or ADC the value obtained from BITalino, Vcc is the operating Voltage (3.3v with a range ±1.5mV), the number of bits (10 bits) and GECG the ECG Sensor Gain(1100).

To use “Telearritmia” program you will need to have a java development environment, electrodes components and a bitalino device.

1. Register:

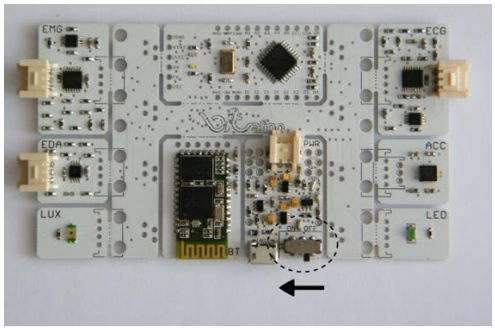
   You will need to introduce your complete name and surname, NIF, date of birth, email, and password (we recommend you use a minimum of 8 characters).

   Once you have registered, you will not be able to change these attributes, so be careful introducing them.

2. Login:

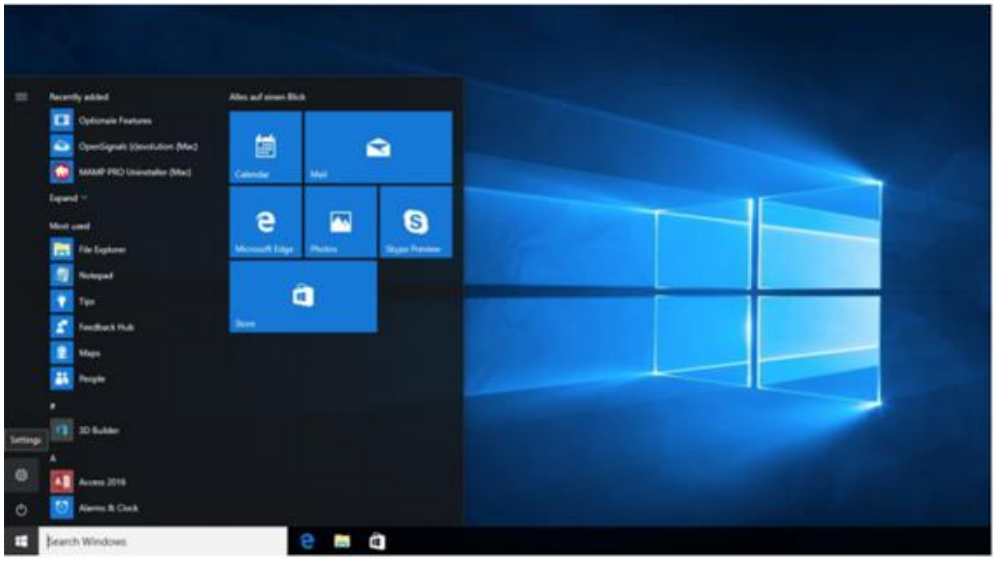
   Introduce your username (NIF) and your password to start the measurement.

3. Measurement:
   a. Turn on the bitalino.

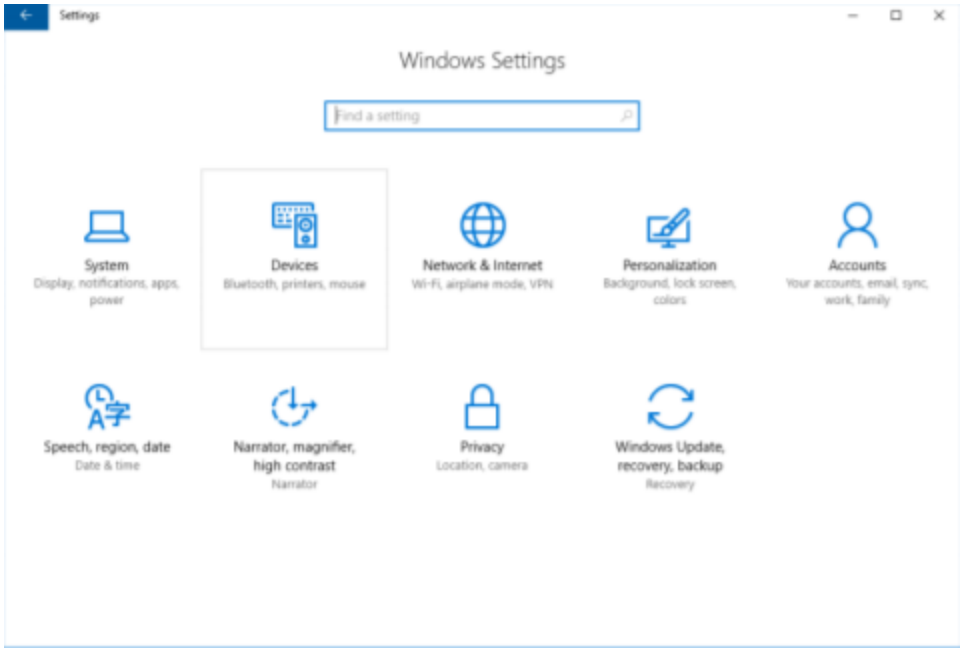


   b. To connect BITalino device to your computer via Bluetooth, click on the start button at the left lower corner in Windows 10 to open the start menu. Click on the gear symbol to open the settings panel of your operating system as can be

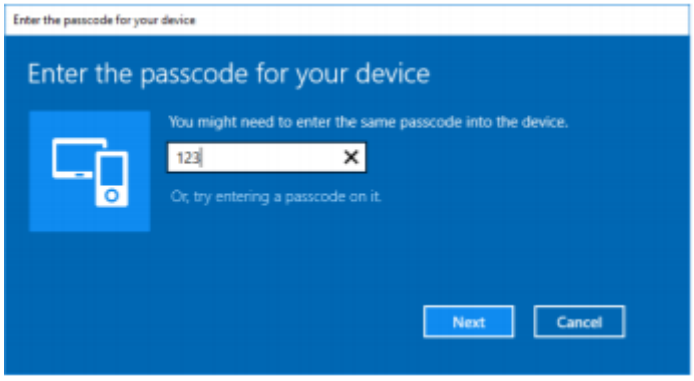
seen below.



In the settings panel, click on the Devices Bluetooth, printers, mouse field to open the device configurations of your system.



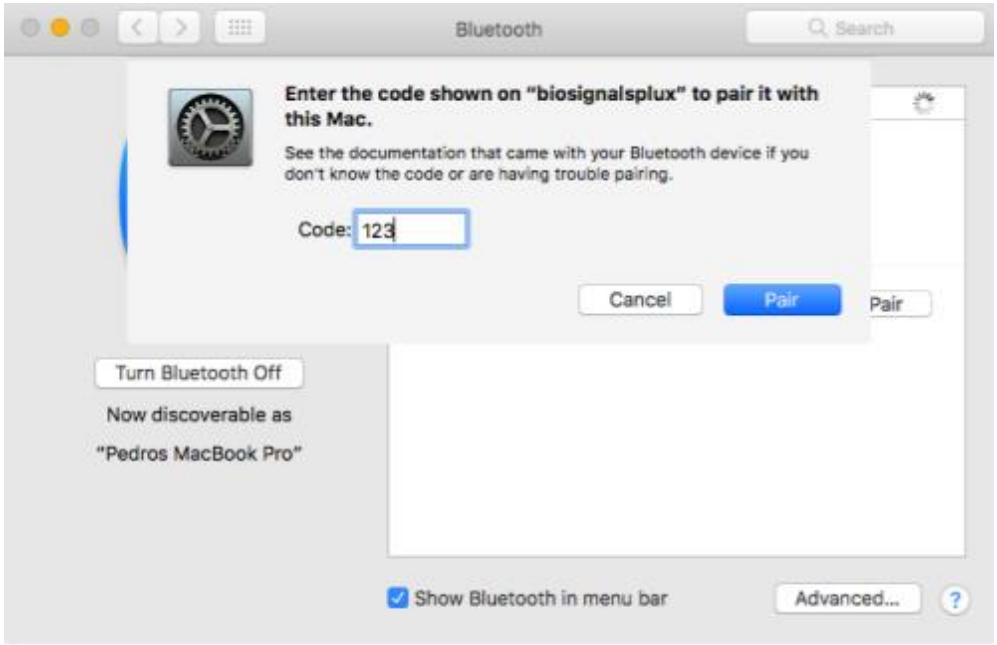
Windows will now try to connect to your device and pop up a window requesting you to enter the passcode (pin) of your device.



On MAC OS X:

To connect your BITalino device to your computer via Bluetooth, click on the Apple symbol at the top left corner of your display and select System Preferences… In the system preferences window click on the Bluetooth symbol to open the Bluetooth settings.

Mac OS X will now try to connect to your device and pop up a window requesting you to enter the passcode (pin) of your device.



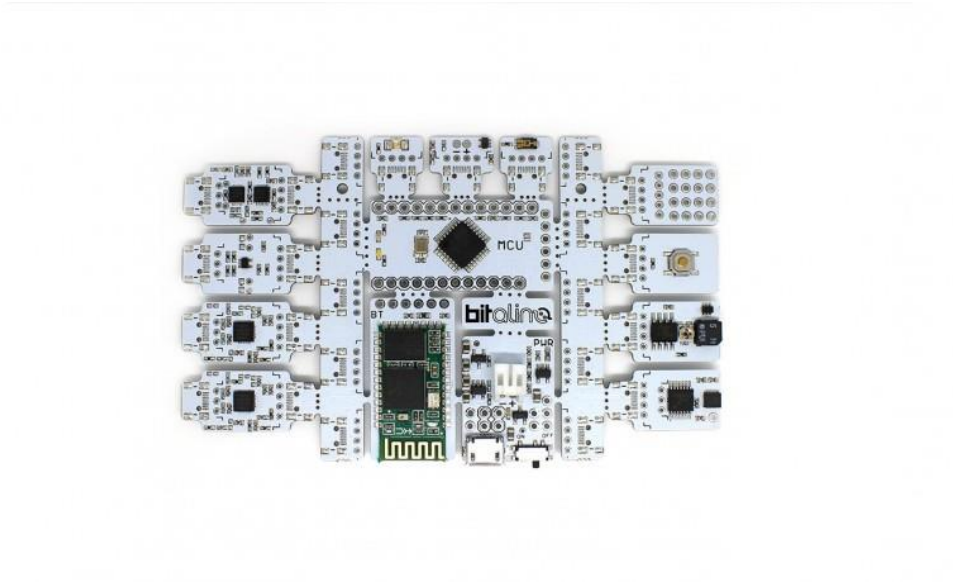
Connecting Devices Manually:

If your device is not listed as an available device to be used in app click on the button "……" to manually add your device using its MAC address. Add the MAC address of your device which can be found at the back of your device into the field below Add your BITalino device manually and click on the enter-arrow below.

c. Electrodes

The acquisition with BITalino is made with three silver/silver chloride (Ag-AgCl) electrodes connected to 1x3 Electrode Leads.  

The electrode leads are connected to their specific output (check for ECG and EDA)



First step: ECG

The electrodes can be placed in several configurations:

1) in the hands, using only two electrodes one on each hand;

2) in the hands and leg, where it is placed one on each wrist and the ground on the leg

3) only in the chest, forming a triangle shape, to the left side of the chest, with the ground electrode as the top corner of the triangle.

Chest electrode placement used for ECG acquisition

Second step: EDA

The EDA acquisition with BITalino was made with two silver/silver chloride (Ag-AgCl) electrodes. These electrodes can be placed in several ways like AB (index - middle finger), AC (index - 3rd finger) or DE (thenar eminence).

d. Press “Record” and wait 30 seconds while the bitalino is recording. Once it has finished, press “Plot” to see the graphics.
e. Press “send” to send the measurements to server.