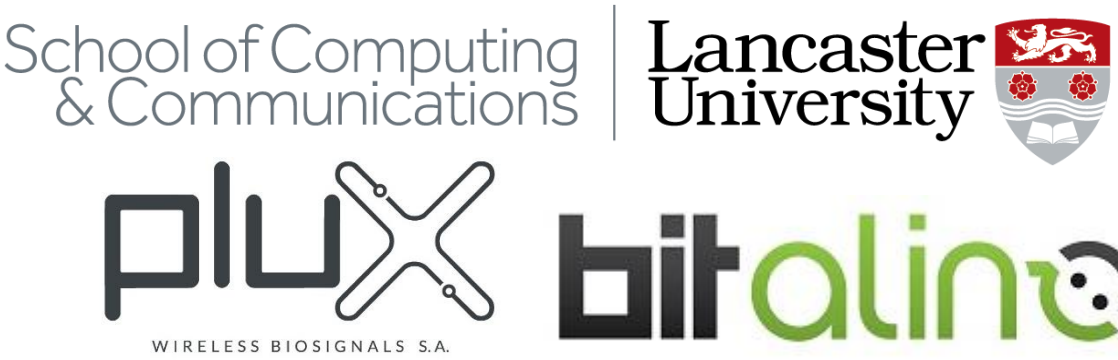


‘Blockly for BITalino’ is a joint venture between two final year Masters students in the School of Computing & Communications at Lancaster University (www.lancaster.ac.uk/scc), and PLUX.

The software was created and developed by Rhys Brady, and the documentation was written by Luke Brown, both supervised by Dr. Jason Alexander. Both Luke and Rhys were involved in the design of the software and ‘bringing biosignals to everyone’.

Should you like any further information on the ‘Blocks for BITalino’ project, how it was developed, or its aims and future objectives please use the contact details below:

‘Blockly for BITalino’ team:

Rhys Brady, *Final year MSci Computer Science (with Industrial Experience) student, Lancaster University,* rhysbrady96@live.co.uk

Luke Brown, *Final year MSci Computer Science with Design (with Industrial Experience) student, Lancaster University*, lukegfbrown1995@yahoo.co.uk

Dr. Jason Alexander, *Senior Lecturer in Human-Computer Interaction, Lancaster University,* j.alexander@lancaster.ac.uk

Hugo Silva, *Chief Innovation Officer at PLUX,* hsilva@plux.info

Blockly for bitalino

Getting Started Guide

What is BITalino?

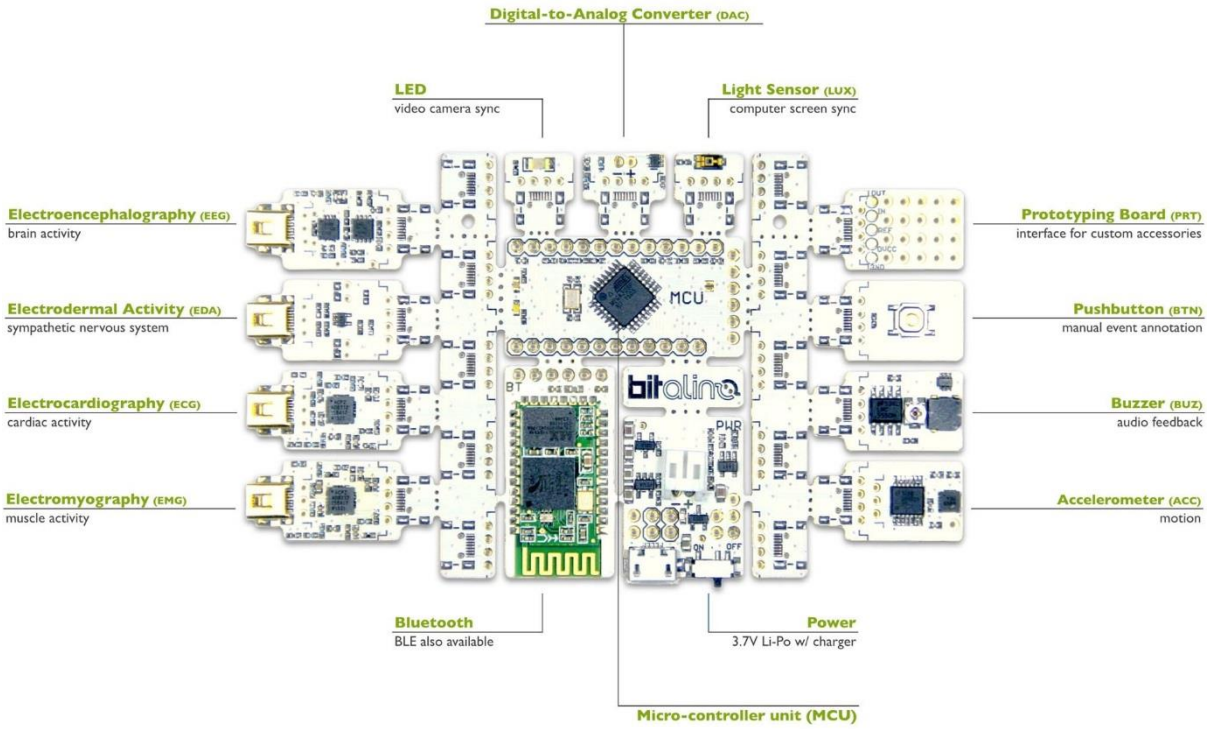


Figure 1: *The BITalino*

The BITalino is a lightweight, programmable physical computing device for biosignal processing.

The hardware device has 4 sensors built into it, which can be used to acquire and process biosignal data. BITalino is capable of recording:

- EEG: Brain activity
- EDA: Sympathetic nervous system activity
- ECG: Cardiac (heart) activity
- EMG: Muscle activity

BITalino is battery powered, and connects to the server via Bluetooth. It really can be taken anywhere, and acquire some unique data.

The device also features an accelerometer, which can monitor changes in speed, motion or direction. It is often combined with the biosignal sensors to produce innovative new project ideas, and to extract biosignal data. The board is fitted with light-sensing (LUX) and LED blocks, to enable synchronization with third-party equipment such as a computer screen or video camera.

BITalino is a versatile toolkit designed to make biosignals available to everyone who may have an interest in measuring the data, and perhaps creating some innovative new product ideas from it. It is also compatible with other physical computing devices.

What do you get in the box?

BITalino is currently provided as a complete toolkit, with everything you would need to get involved in the world of biosignals. In the box, you get the BITalino board, a rechargeable battery and a set of electrodes to collect the data.

These electrodes are connected to the BITalino with various cable configurations (two-lead electrode cable assembly for ECG and EDA; a three-lead electrode cable assembly for ECG and EMG)

Getting started with BITalino

'Blockly for BITalino' involves a hardware and software setup.

The following steps will show how to connect up the BITalino and the electrodes, so you can begin collecting and processing biosignal data in no time! The steps below use the EMG sensor as an example, but the process is similar for all the sensors on the board (see subsequent sections).

Before you get started, ***make sure you have ServerBIT installed***. We will connect to this later, but first download the software from this link: https://github.com/BITalinoWorld/revolution-python-serverbit

Step 1: Check you have everything you need

The very first thing to do is connect your electrodes to the cabling. The 3-cable configuration is shown in the image below, but you can use the 2-cable configuration also supplied if you prefer.

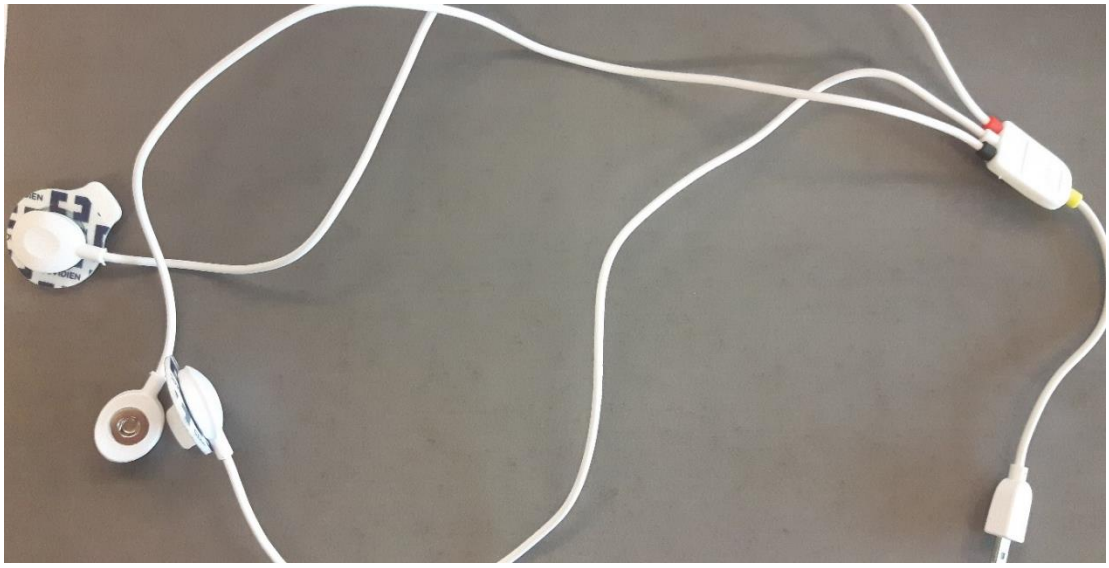


Figure 2: *Three wire configuration*

This image shows the 3-cable configuration with 2 out of 3 electrodes attached. In this tutorial, we will show how to attach a single electrode, so you will need to complete this 3 times for a fully connected cable configuration.

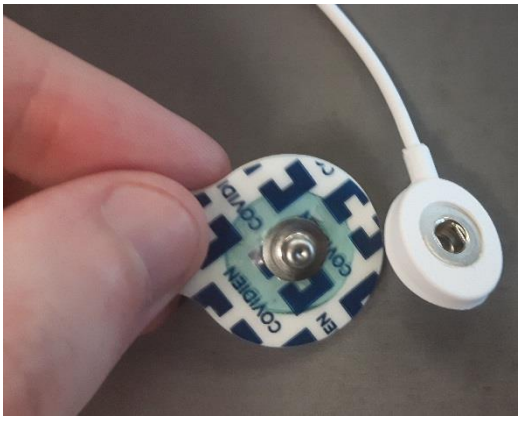


Figure 3: *Unconnected electrode*

First, peel back the sticky pad, so you can see the blue gel like in the image.

Then, push the silver stud on the electrode into the hole on the connector.

Figure 4: *Connected electrode*

Your 3-cable configuration should now look like this (assuming you have repeated the steps for each electrode):

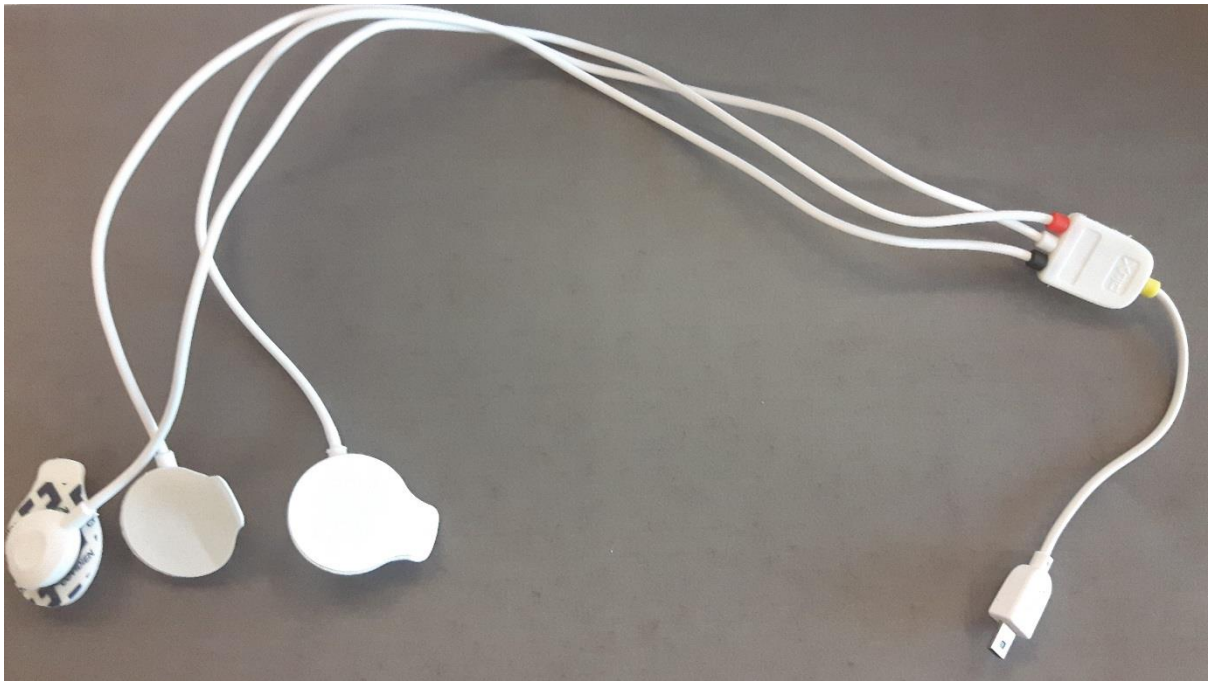


Figure 5: *Fully connected 3-cable configuration*

Before you get started, it's a good idea to check you have all your components. In the box, you should have everything shown in the image below:

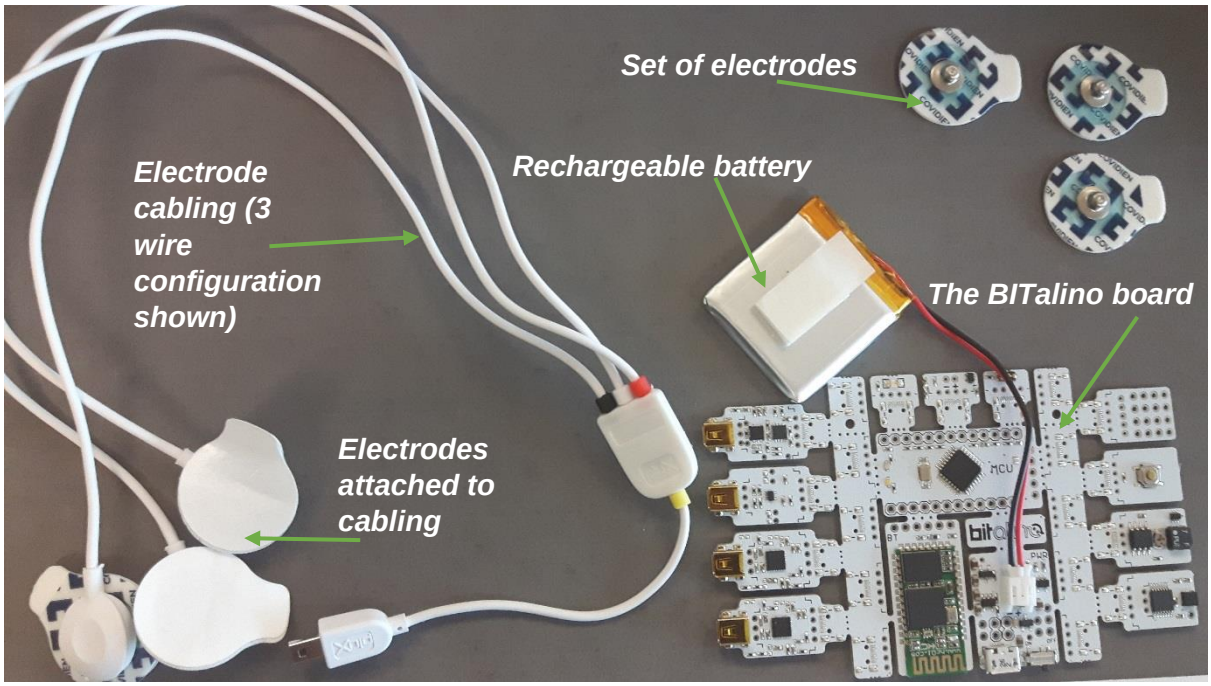
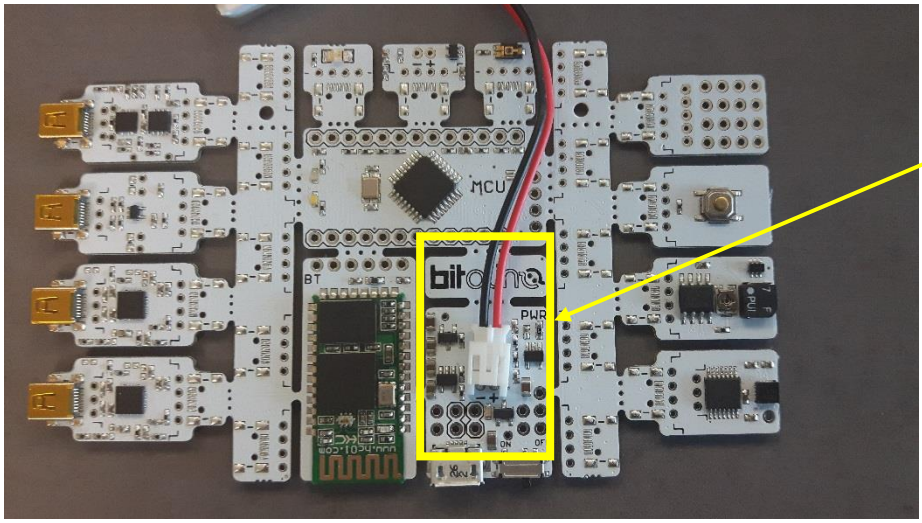


Figure 6: *Full set of BITalino kit*

(if you haven't already, make sure you attach the electrodes to the end of the cabling, otherwise you won't be able to measure anything!)

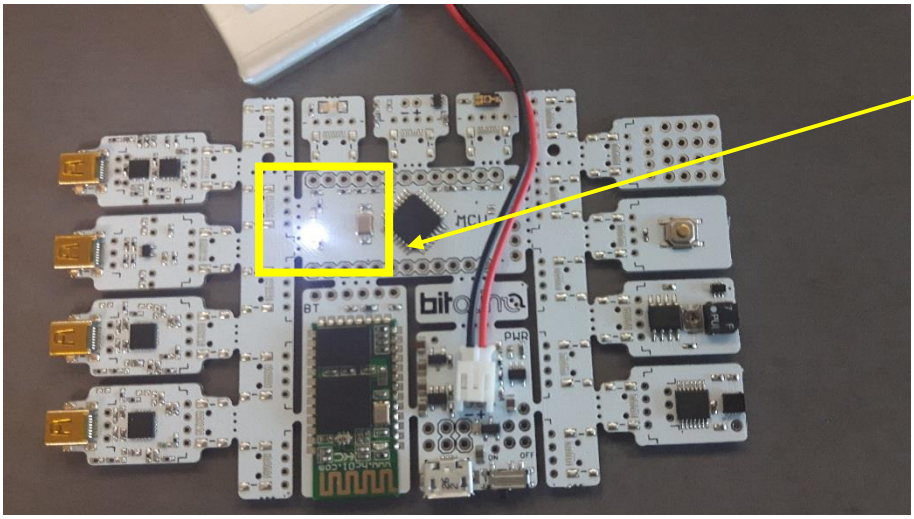
Step 2: Connecting the power



Connect the battery to BITalino here (hint: look for 'PWR')

Figure 7: *Indicating power cable*

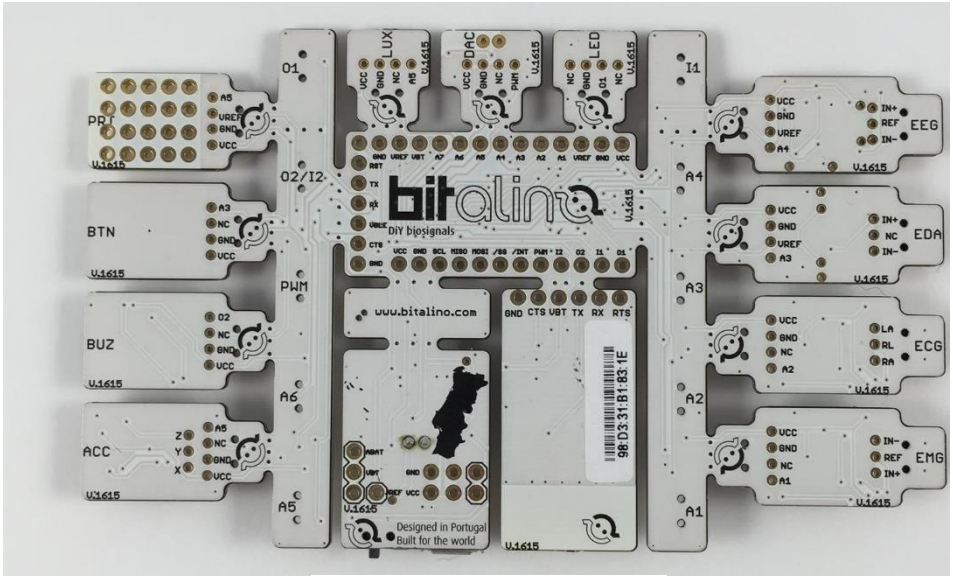
You can then test the board is working by flicking the on-off switch, and the white LED will light up to show you are ready to go!



We're ready to go!

Figure 8: *This light will blink when the power is connected*

Step 3: Connecting the electrodes



Once you have the power working, it's time to connect up the electrodes that will actually monitor the biosignal data.

Flip over the BITalino board so it looks like Figure 9:

Figure 9: *BITalino from the back*

Then, attach the electrodes to the end of the cabling, and plug in the cable to whichever sensor you would like to use. This will depend on what biosignal you would like to measure, but in this tutorial, we are showing how to measure EMG (muscle movement).

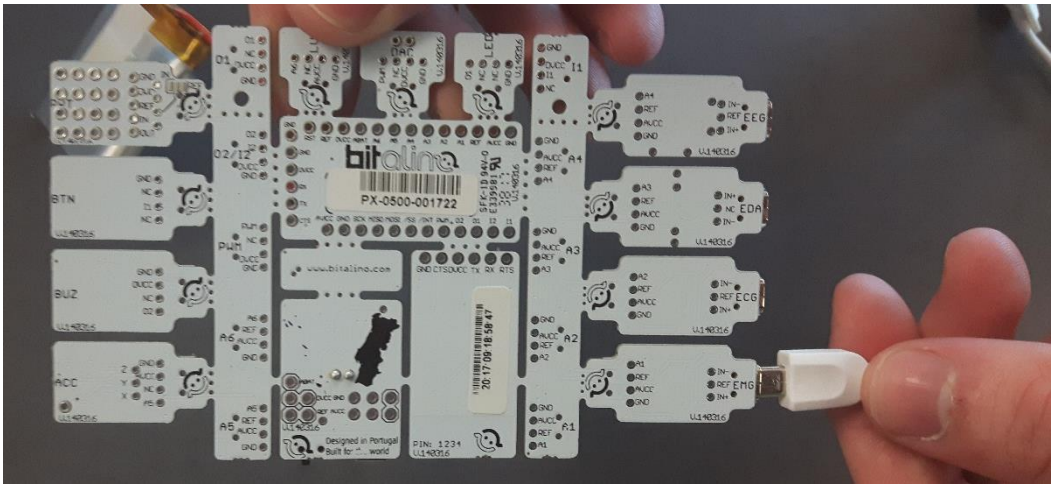


Figure 10: *Attaching the electrode cable to the integrated sensor (in this case EMG)*

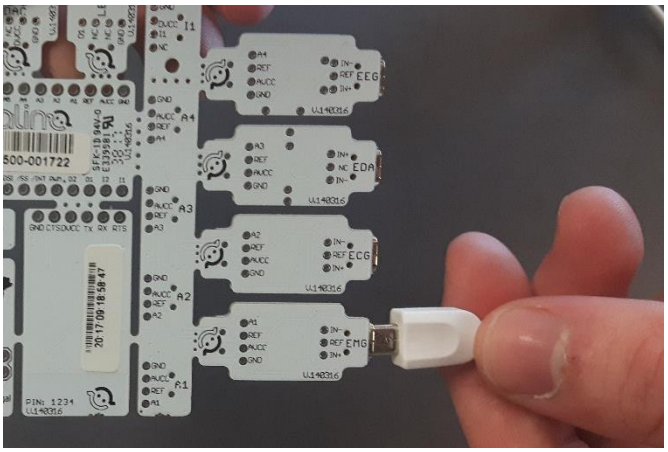


Figure 11: *Zoomed in version: Attaching the electrode cable to the integrated sensor (in this case EMG)*

Figure 11 shows how to connect the electrodes (and cabling) to the EMG sensor, which means we will be able to measure muscle movement.

If you would like to measure other biosignals (e.g. heart rate or brain waves), simply plug in the cabling to one of the other sensors above, as shown in the image.

Note that you can only measure one biosignal at a time!

Step 4: Connecting to the 'Blockly for BITalino' interface

In order to process and visualise the biosignal data, we will be using the 'Blockly for BITalino' interface. BITalino uses Bluetooth to connect to this, so before continuing, make sure the board is connected via your Bluetooth connection. **Consult our Quick Start guide (**http://bitalino.com/en/quick-start-guide**) on how to do this.**

Once you are connected to Bluetooth, you will then need to run the server. You can do this by opening the batch file, but please don't forget to keep it running as long as you are using the interface. If you stop the server, you'll stop recording biosignals!

Step 4.1: Connecting to ServerBIT

First, make sure your BITalino is on.

Then, run the ServerBIT.bat file from your working directory (by double clicking on it) and check that the interface says "connected" (you may need to refresh the interface if you have already loaded it before this step).

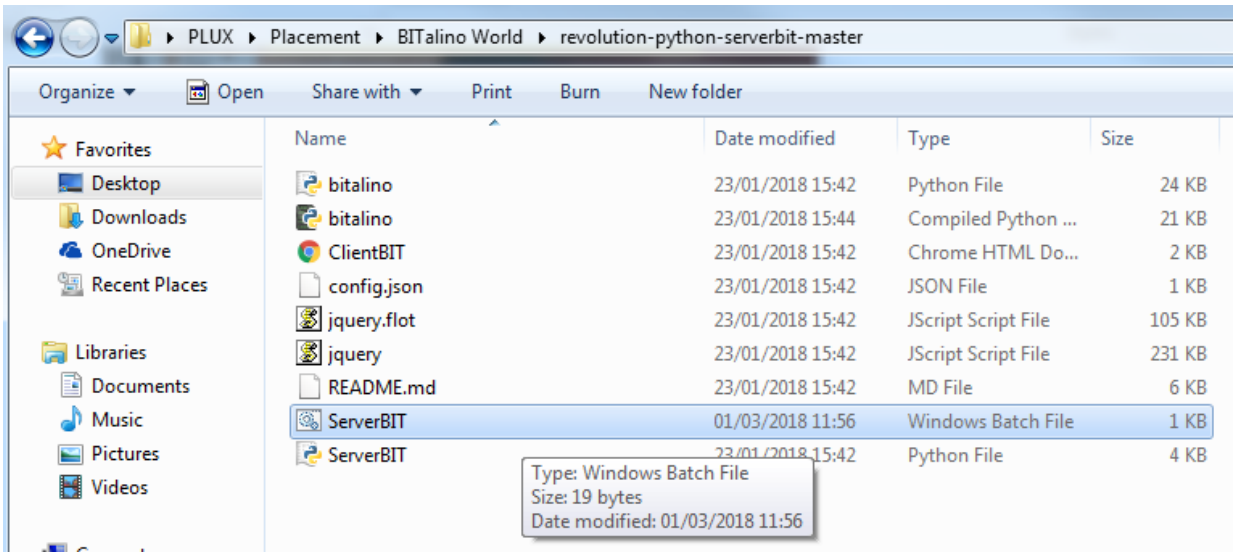
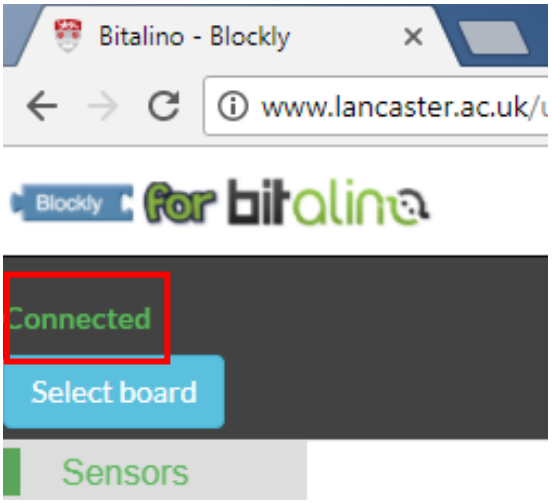


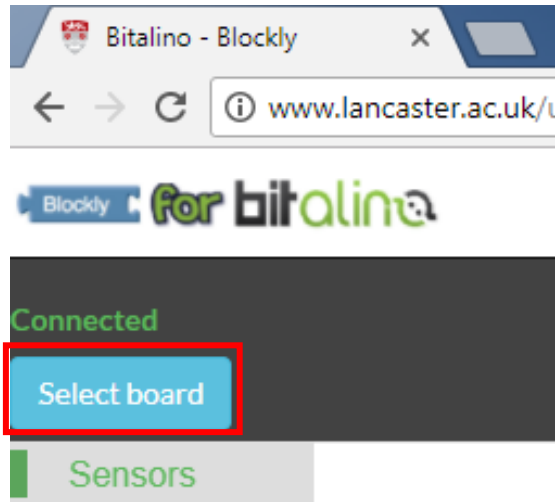
Figure 12: *Running the ServerBIT batch file (example working directory is shown)*

The image above shows the .bat file in the working directory. Click on it to run.



This screenshot shows the 'Blockly for BITalino' interface, fully connected.

Figure 13 (left): *Showing the interface fully connected*



Step 4.2: Selecting your board

There are three versions of the BITalino board, so you need to make sure the interface knows which one you are using! You can do this by clicking the 'select board' button.

Figure 14 (left): *Showing how to select your board*

Figure 15: *Showing the different configurations available*

You should now select which version of the BITalino board you are using. When the image of the board is selected, only the sensors and channels used in that configuration are available for use (e.g. if EMG is not supported with an older version, that block will not appear in the left-hand pane, if the older board is selected).

Your screen should now look like this:

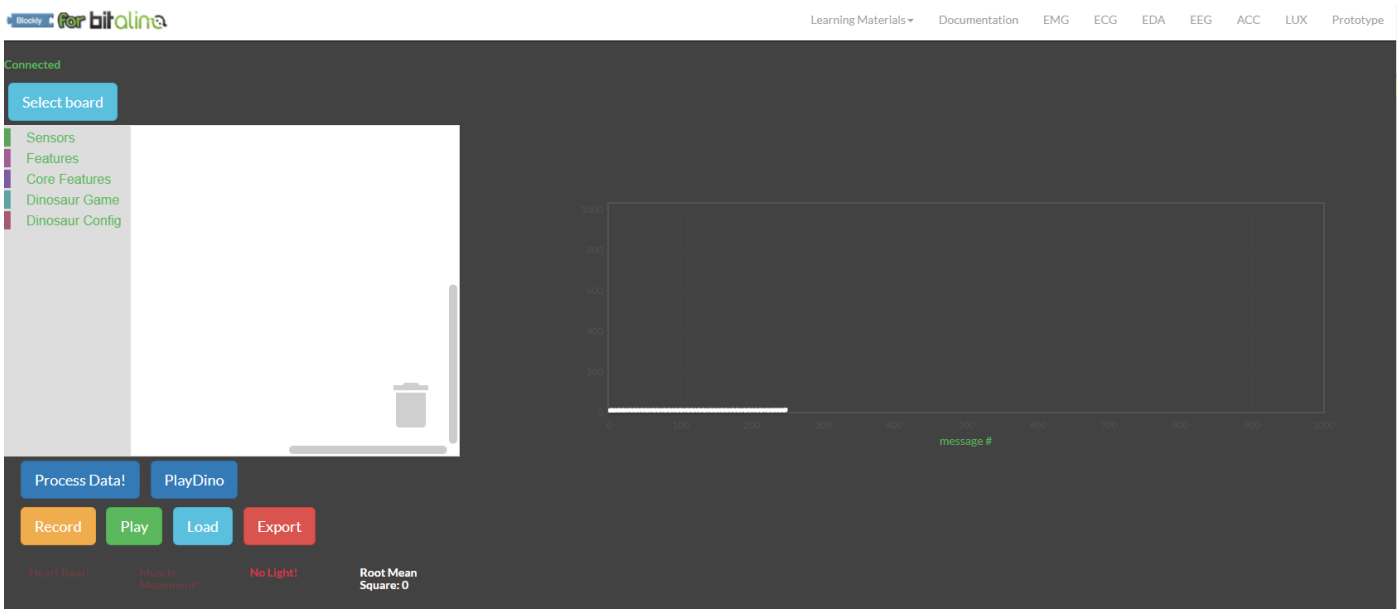


Figure 16: *'Blockly for BITalino' interface*

Step 5: Attaching the electrodes

Once you are fully connected, it's time to attach the electrodes and start playing with biosignals!

The images below show how to attach the electrodes to your arm, for measuring EMG with the 3-cable configuration. If you are measuring another biosignal, please consult our notes on these later in the tutorial.

If you haven't already, unpeel the electrode cover to fully reveal the sticky blue surface, as shown in the picture below.

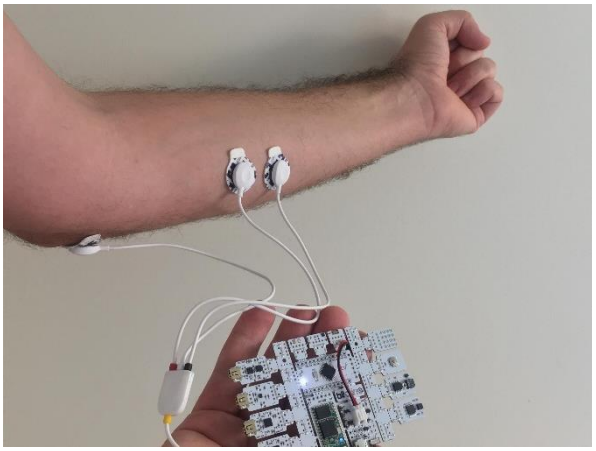
Figure 17 (left): *Peeling away the electrode cover*

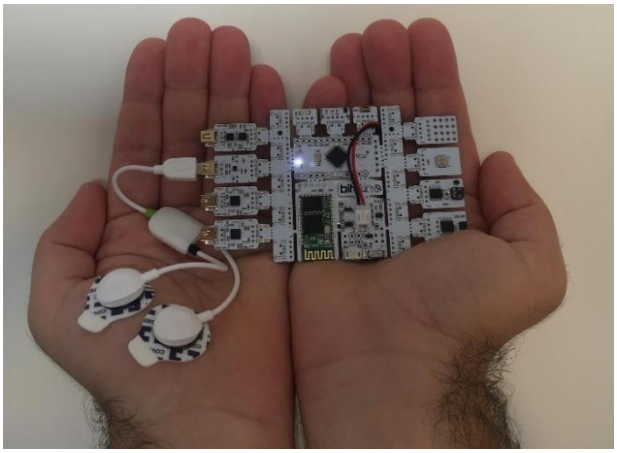
Figures 18 & 19: *Connecting the electrodes*

The white coloured electrode of the three should be attached to a firmer surface on your arm, such as near a bone.

Flip over to the other side of your arm and attach the remaining two electrodes (red & black) anywhere on your arm (the nearer the first electrode the better).

Figures 20 & 21 (below): *Alternative attachment methods*





Showing an alternative way to attach the electrodes (EMG is shown on the left, and EDA on the right)

Step 6: Playing with blocks

Up to now, the hardware (the BITalino board and the electrodes) and software (the interface on the screen) have been a bit separate. Now is the time to bring them together!

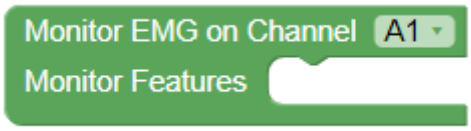


Figure 22: *Example EMG block*

Select the EMG block from 'Sensors' and drag it into the blocks window. This block allows you to monitor EMG (in this case), on channel A1. Make sure that the correct channel is selected for your board (it is A1 by default but check on the back to make sure).

The hardware is connected via Bluetooth, so as you drag the block into the block space and tense your arm, you will need to also select 'Process data': it should then start recording data in the graph, as seen in the example below.

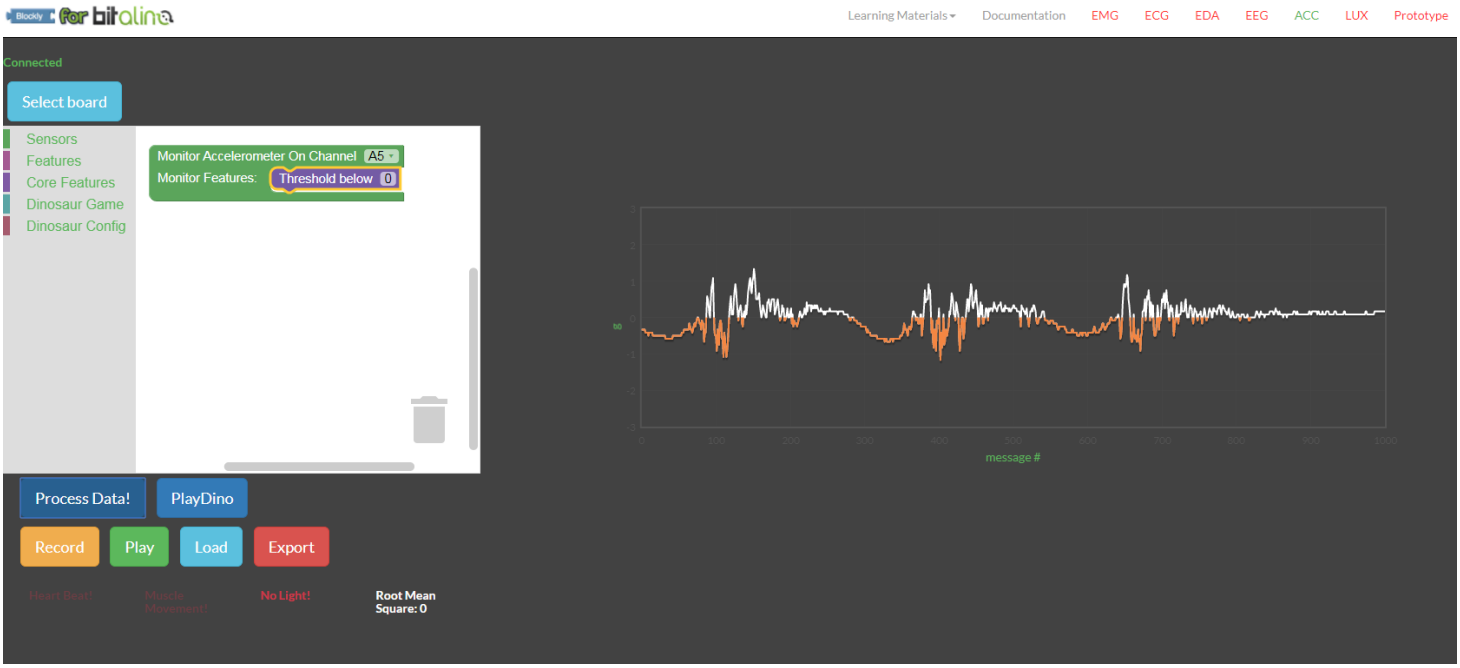


Figure 23: *The interface in operation*

Dragging the block as shown above into the block window will allow you to monitor the EMG signal, and if you wish, you can add in specific features (from the 'features' or 'core features' sections) to monitor as shown below.

You can see text displaying which biosignals are currently being monitored at the top of the interface. If the acronym is in green, it is being monitored and if the acronym is red, then it is not currently being monitored. Third party sensors are also supported under 'Prototype'.

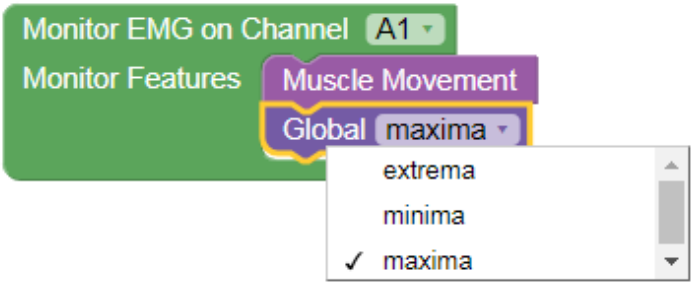


Figure 24: *Example EMG block with added monitoring features*

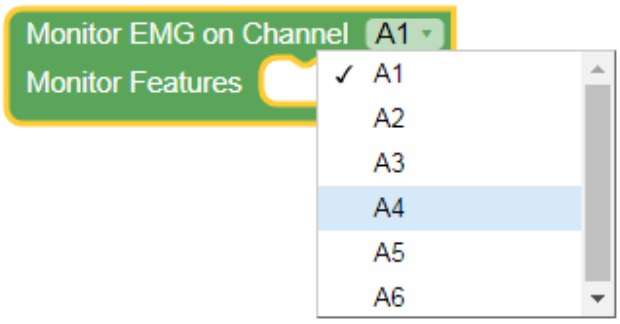


Figure 25: *Configuring the channels*

In this case, we are measuring the EMG and highlighting the global maxima of the data (see Figure 24).

Different versions of BITalino have different channel mappings, particularly with the channels used to monitor a certain sensor (e.g. EMG). On one device it could be set to one channel, but on a newer version, this could be monitoring an entirely different sensor. The drop-down (see Figure 25) allows you to configure the channel you are monitoring on, if required (note it is set to the default channel configuration for each sensor depending on your chosen board).

Note: if you're monitoring another biosignal, each sensor has its own block, so just swap out the EMG block for the signal you are measuring.

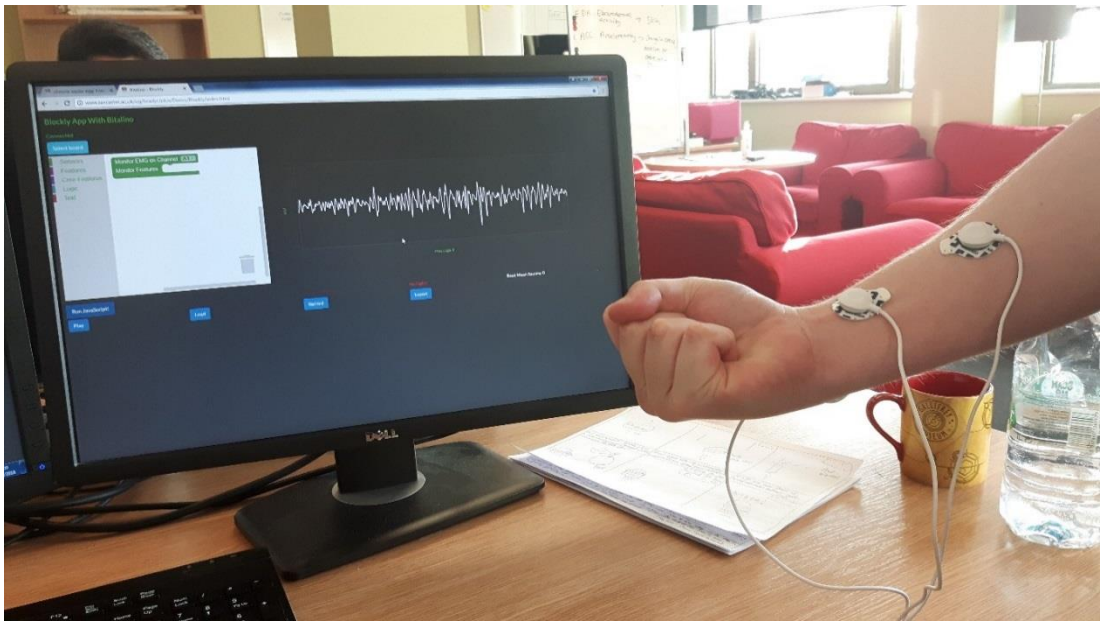


Figure 26: *Interacting with the interface*

The picture above shows the electrodes connected to the persons arm, and the screen. The user is tensing their arm and the interface is displaying their EMG data.

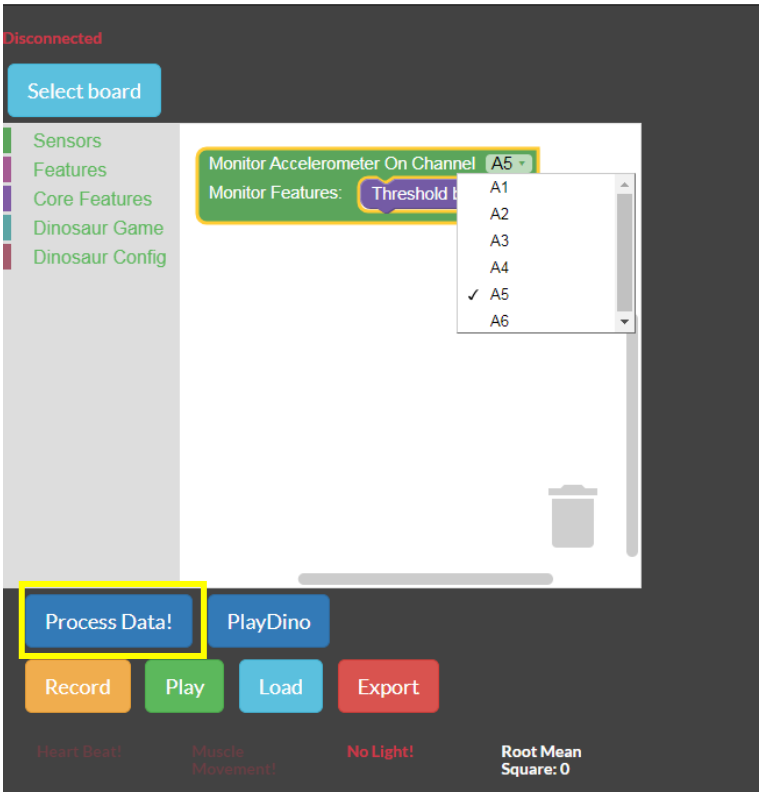
Figure 27: *Interacting with EMG using the interface*

Here, the user is tensing their arm a bit more, and the data has updated in real time.

Step 7: Obtaining data

The main aim of the interface is to allow basic processing of biosignal data, and associated data visualisation. However, it also allows you to play, load, record and export the data as follows:

Step 7.1: Visualising and processing biosignal data



There are some buttons you will need to interact with. The most important of these is the 'Process Data' button.

Once you've finished programming with the blocks, you will then need to click this button to visualise the game and graph. If you would like to keep this data, click 'record'.

Figure 28 (left): *Indicating the 'process data' button*

Step 7.2: Exporting biosignal data

Clicking the ‘export’ button will allow you to download your biosignal data as a .txt file.

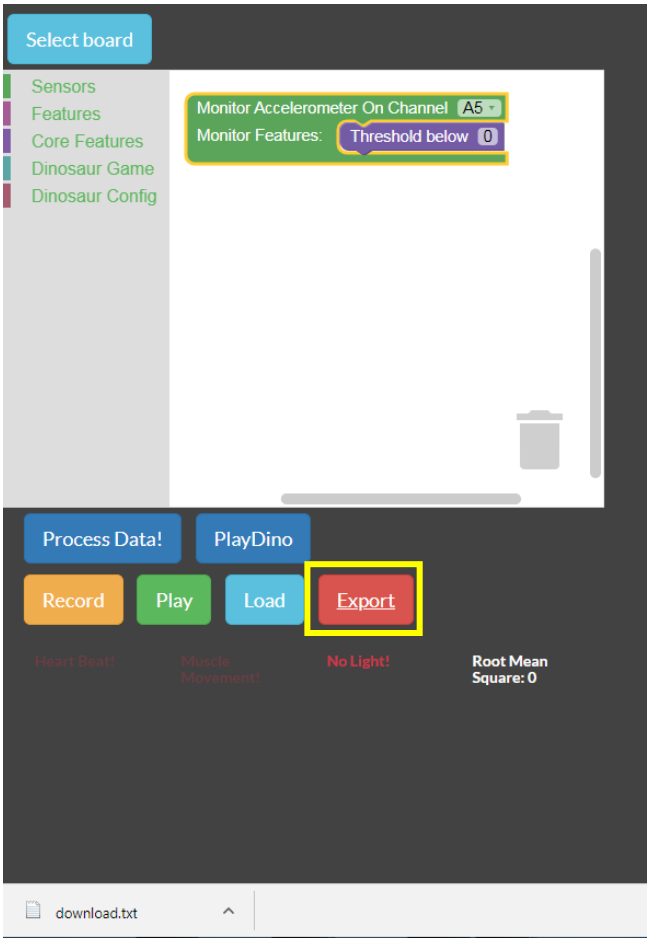


Figure 29: *Indicating the ‘export’ button*

Step 7.3: Loading biosignal data

Clicking ‘load’ will open a file directory, from which you can load and visualise a previously exported data file. If you would like to play this data once loaded, click ‘play’ and it will visualise it for you.

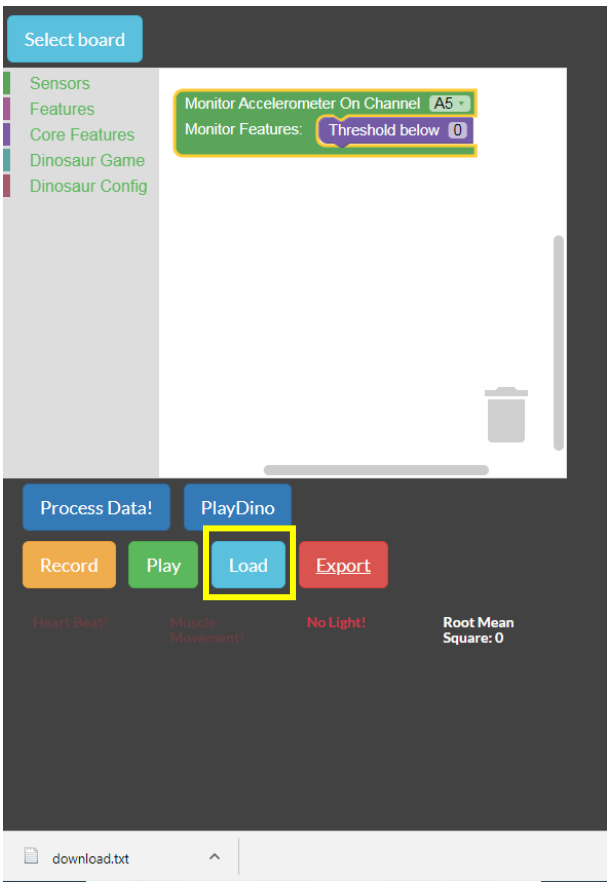


Figure 30: *Indicating the ‘load’ button*

Step 8: Familiarise yourself with the ‘Blockly for BITalino’ interface

At this point, you should have the BITalino board fully connected via Bluetooth, and have the server running. You should also have the electrodes suitably attached to your arm (or elsewhere if you are measuring a different biosignal).

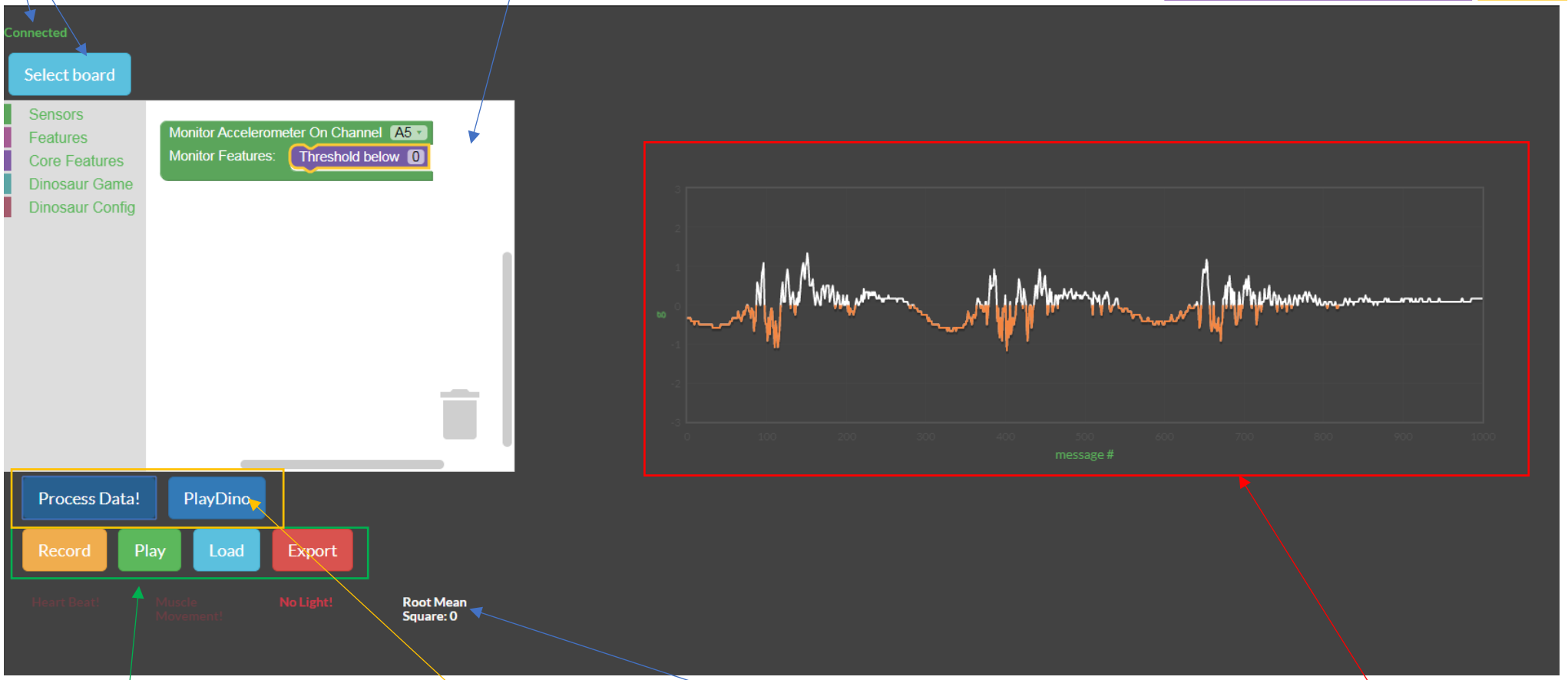
It’s a good idea to have a quick look at the Blockly for BITalino interface now, so you know how it all works before you get started.

Blockly for BITalino relies on a connection to serverBIT. This shows whether you are connected to it or not. Clicking the 'select board' button allows you to select your board

This is the block workspace, allowing you to "drag and drop" blocks to process data. You can delete blocks by dragging them to the bin.

Links to documentation and learning resources

Each of the biosignals that are being monitored are displayed in green here. Third-party sensors are supported via 'prototype'.



These buttons allow you to record, load and export the data (see above).

These should be clicked to visualise the data and/or play the game

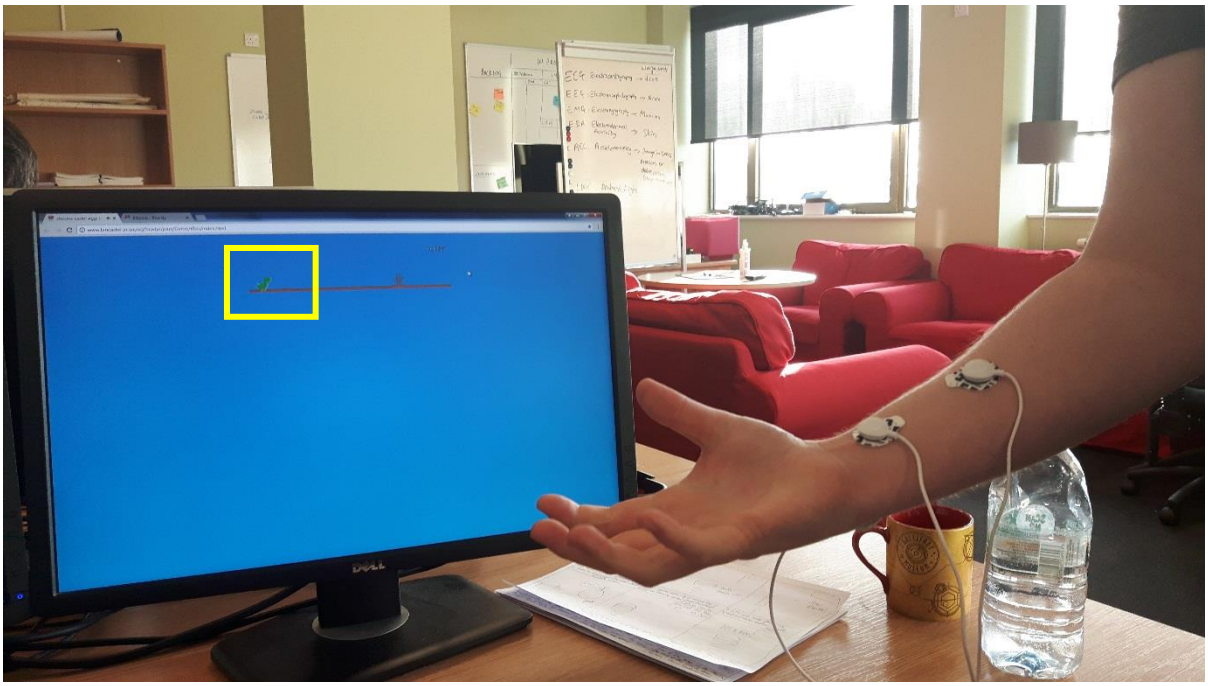
If 'PlayDino' button is clicked, the game space becomes available to see and interact with

Root mean square values are displayed

Any biosignal data will be visualised here in the graph. The gamespace will be visible below, when 'PlayDino' is clicked.

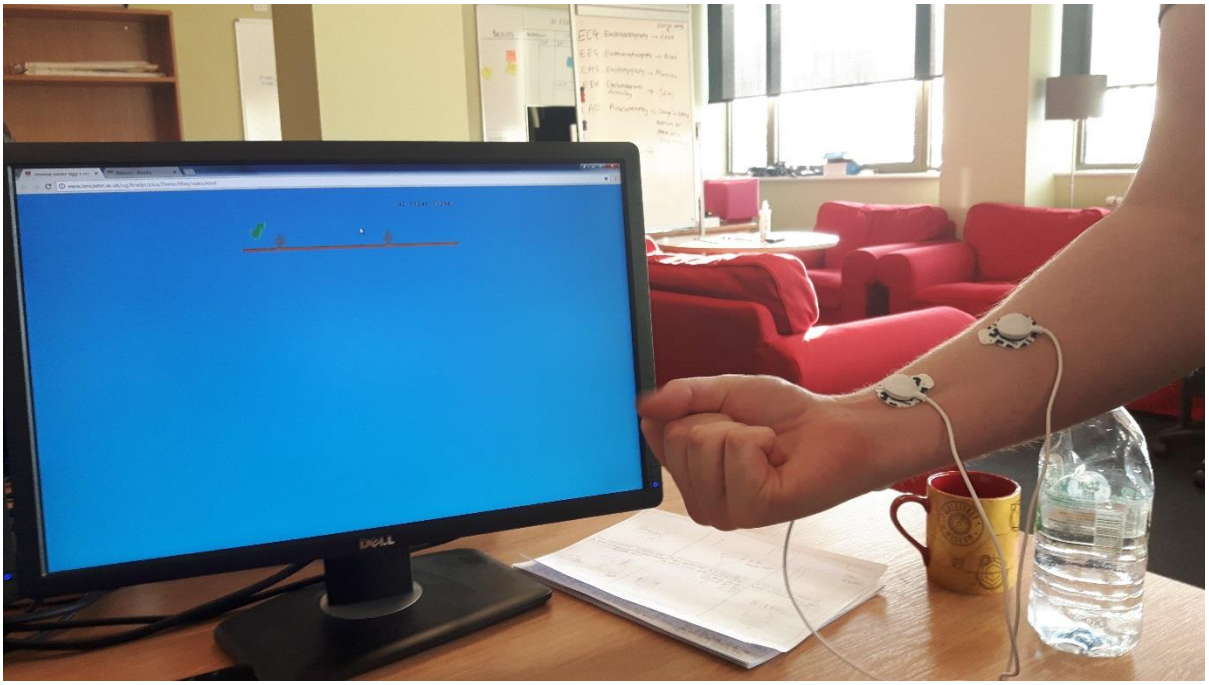
Step 9: Having some fun!

We currently have the interface measuring some EMG data from your arm, but there's some pretty cool things we can do with that data!



Figures 31 & 32: *Interacting with the dinosaur game*

In this example, we have the EMG data being used to control the 'Hugo the Dinosaur' game (currently Hugo is flat on the ground, at the start of the game)



Figures 33 & 34: *Showing the effect of the EMG force on the game*

If the user tenses their arm, Hugo can jump over the obstacles! Why not have a go at this 'Hugo the Dinosaur' activity sheet? In this activity, you can play the dinosaur game at the same time as monitoring your muscle movement.

This illustrates the dinosaur gamespace being visible, once the PlayDino button has been clicked.

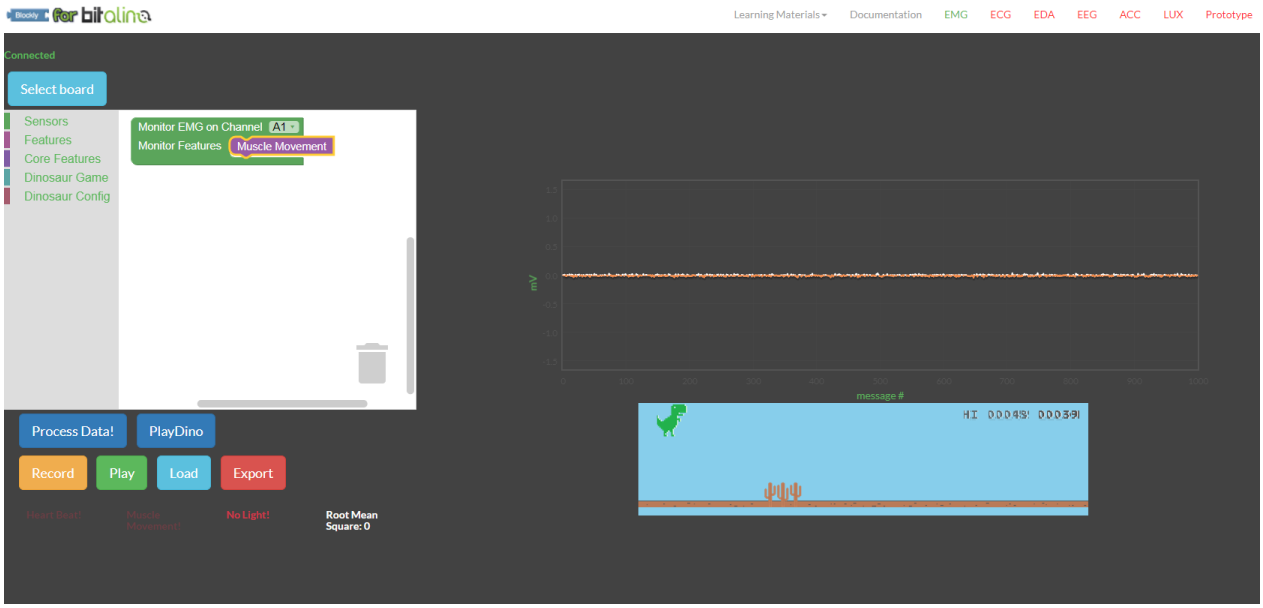


Figure 35: *Visualising the game space*