



Supported by  
**ARTS COUNCIL  
ENGLAND**

# Bio-OS Help Guide

October 2011

[<http://www.bio-os.org/human-geography>]  
[<http://x2.i-dat.org/datalab>]



## Index

<b>1. About the project</b> .....	<b>3</b>
<b>2. Bio-OS System</b> .....	<b>4</b>
<b>3. Bio-OS Input</b> .....	<b>5</b>
3.1. Wearable sensing hardware .....	5
3.2. Set Up Instructions.....	8
3.3. Replacing the Batteries: .....	11
3.4. Mindwave headset.....	13
<b>4. Bio-OS Server</b> .....	<b>14</b>
4.1. Data Storage Server .....	14
4.2. Trigger Logic Editor .....	15
4.2.1. <i>Guide to writing triggers conditions</i> .....	15
4.3. Data Injector .....	17
4.4. Trigger Checker .....	17
4.5. Gateways .....	17
4.6. Pigeonhole Service .....	18
4.7. Current Value Server .....	18
4.8. Live Stream Server .....	18
<b>5. Bio-OS output</b> .....	<b>20</b>
5.1. Location specific installation .....	20
5.2. Facebook/Mobile Network/Email.....	21
Contact:.....	22

## 1. About the project

Bio-OS is the result of an i-DAT Collaborative Data Lab R&D project, supported by Arts Council England, which has developed the ‘provocative prototypes’, Bio-OS 1.0, that lead to new practices, knowledge and resources for artists and transdisciplinary practitioners. The intention is to make the data generated by human and ecological activity tangible and readily available to the public, artists, engineers and scientists for potential social, economic and cultural benefit, exploring the transformative potential of digital technology to nurturing new cultural forms. The development process is documented at - <http://x2.i-dat.org/datalab/>.

This user guide is only intended for the partners commissioned for this project and should not be distributed wider as all server details are included.

By using these prototypes or related knowledge provided, you accept and agree to be bound by the “Terms and Conditions of Service”. If you do not agree to the Terms and Conditions of Service you should not use these and therefore decline this Agreement

### “Terms and Conditions of Service”.

1.1 You acknowledge that ‘Bio-OS 1.0 and all related prototypes and knowledge’ (Service) are based on unstable prototypes built for testing and experimentation in controlled environments. I-DAT and the Plymouth University do not take any responsibility for any direct or indirect damages caused through the use or implementation of this Service.

1.2 You acknowledge that all intellectual property is open and shared within and beyond the collaborative team. All source code is shared with the participants within the following Creative Commons license in return for acknowledging i-DAT and the Arts Council England.



Bio-OS by [i-DAT](#) is licensed under a [Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported License](#).

1.3 That users of this Service can create Content through the use of this Service in various forms. I-DAT acknowledges and agrees that, subject to the Terms and Conditions of Service, you will retain applicable copyright and any other intellectual property rights with respect to any Content you create using the Service, to the extent that you have such rights under applicable law.

## 2. Bio-OS System

The key elements of the system architecture, outlined below, are discussed in the following sections below.

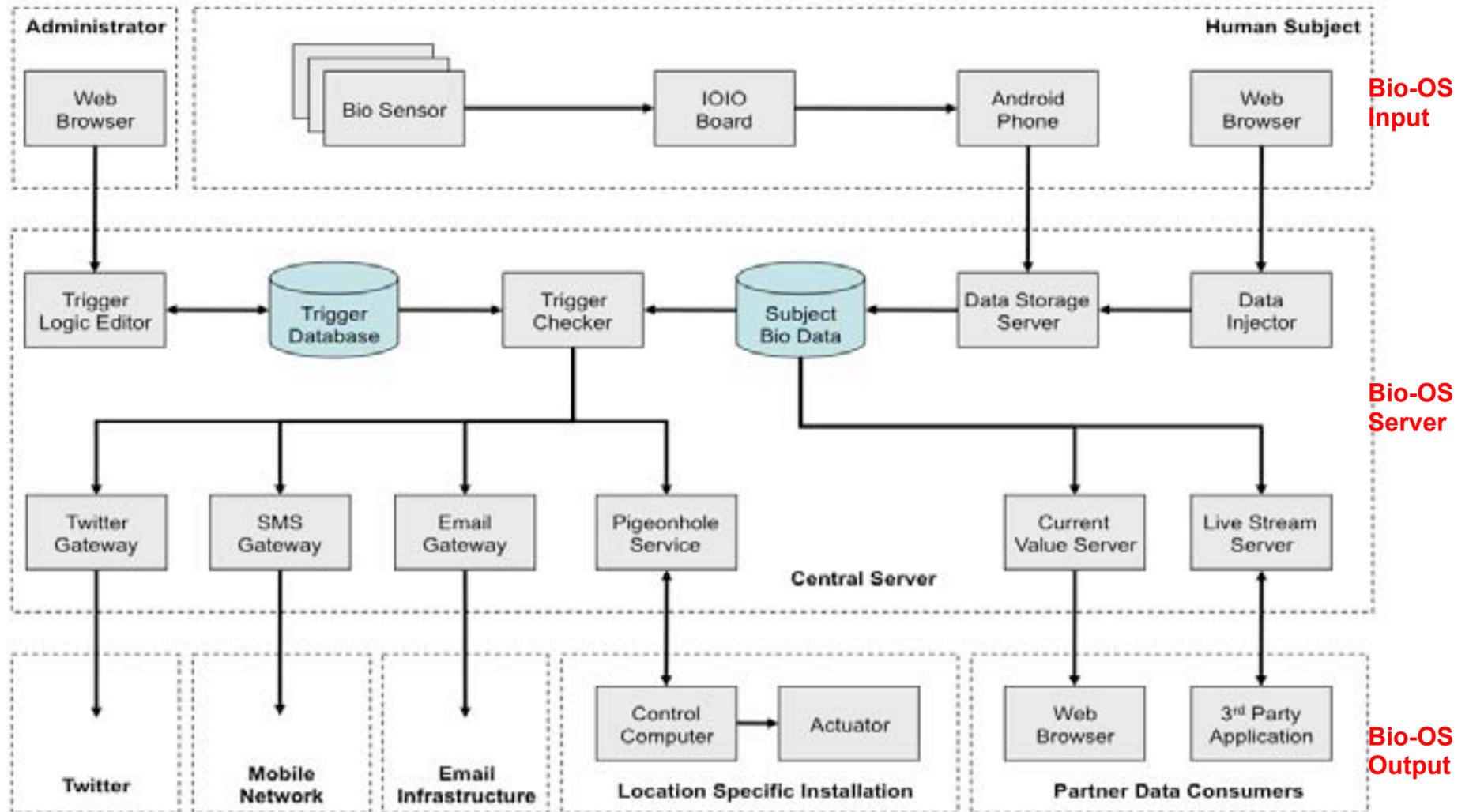


Figure. 1 Bio-OS System Architecture

### 3. Bio-OS Input

#### 3.1. Wearable sensing hardware

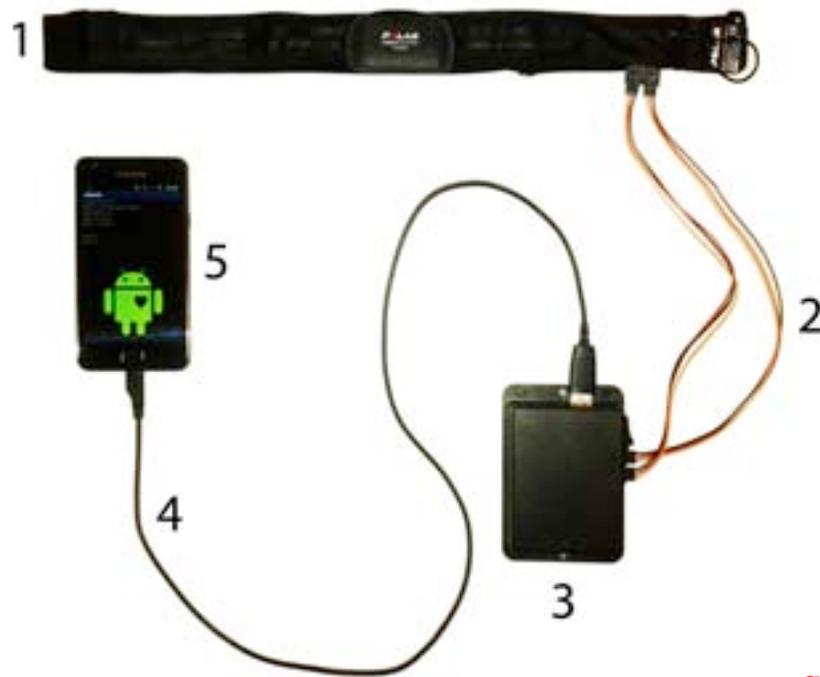


figure 2

## 1. Sensor Strap:

- 1a. The electrode areas on the reverse side of the strap detect heart rate.
- 1b. The transmitter sends the heart rate signal to the prototype unit.
- 1c. Sensor daughter board (temperature – Galvanic Skin Response).
- 1d. Stretch (Breathing) sensor.

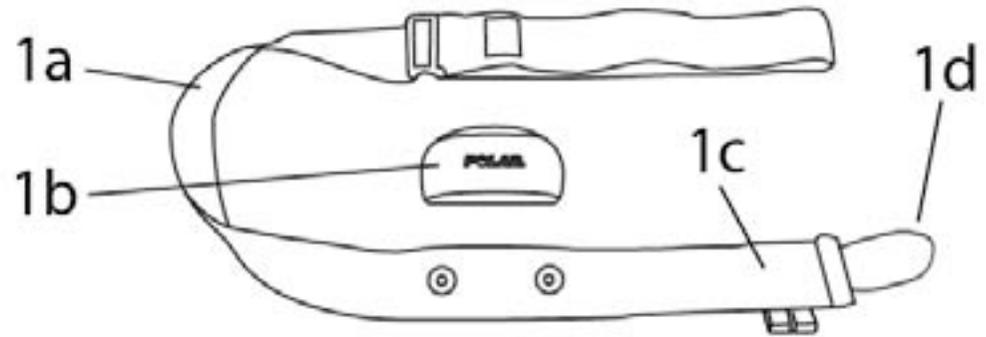


figure 3

## 2. Data / Power Cables

- 2a Data cable. Identified by BLUE dot.
- 2b Power cable. Identified by RED dot.

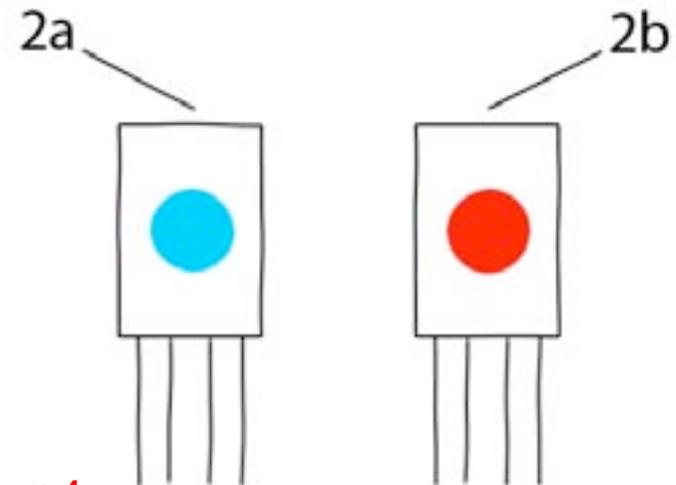
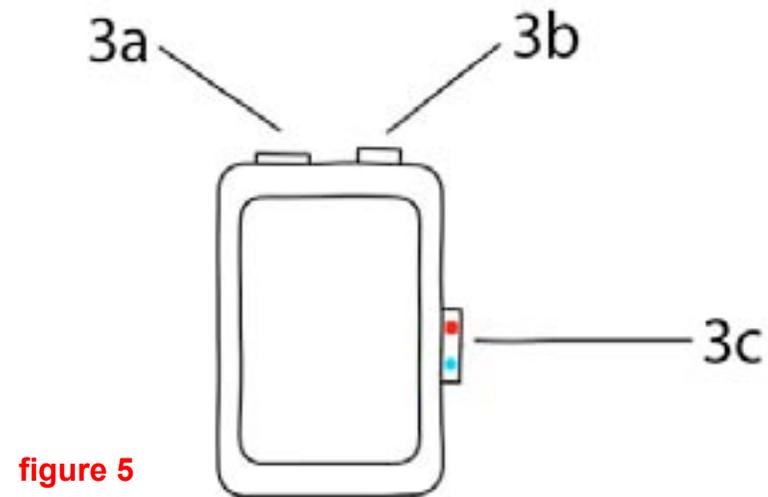


figure 4

### 3. Prototype unit

- 3a. Power On / Off switch.
- 3b. USB connector.
- 3c. Data / Power cable connectors.



### 4. USB Lead

- \* USB to mini USB

### 5. 3G Android Phone

- \* Android 1.5 or greater
- \* 3G communication
- \* GPS

## 3.2. Set Up Instructions

1. Attach the transmitter to the sensor strap (1b).
2. Connect the RED Power Cable (2a) to the Sensor Strap RED connector.
3. Connect the BLUE Power Cable (2b) to the Sensor Strap BLUE connector (2b).

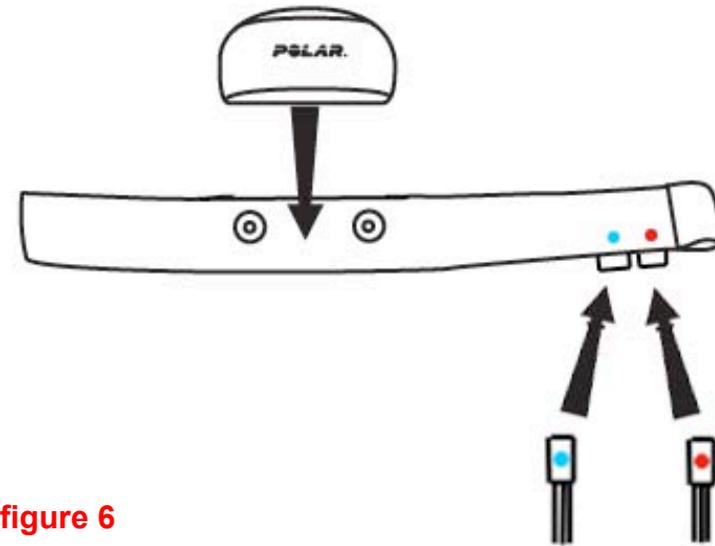


figure 6

4. Tie the strap around your waist, and attach the stretch sensor (1d) to the other end of the strap.

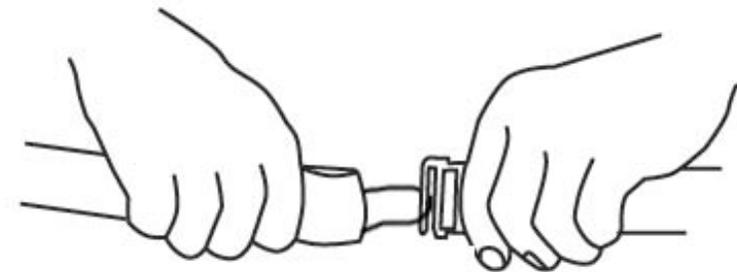
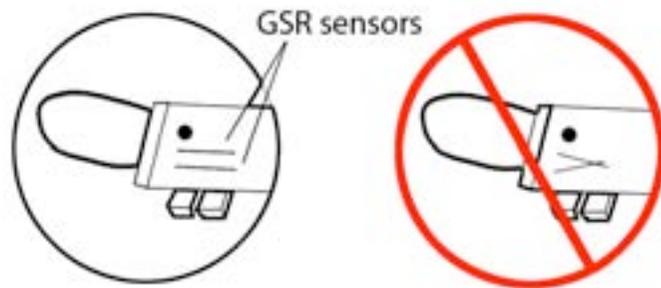


figure 7

5. Comfortably place the sensor strap just below your chest muscles.

**CAUTION!**

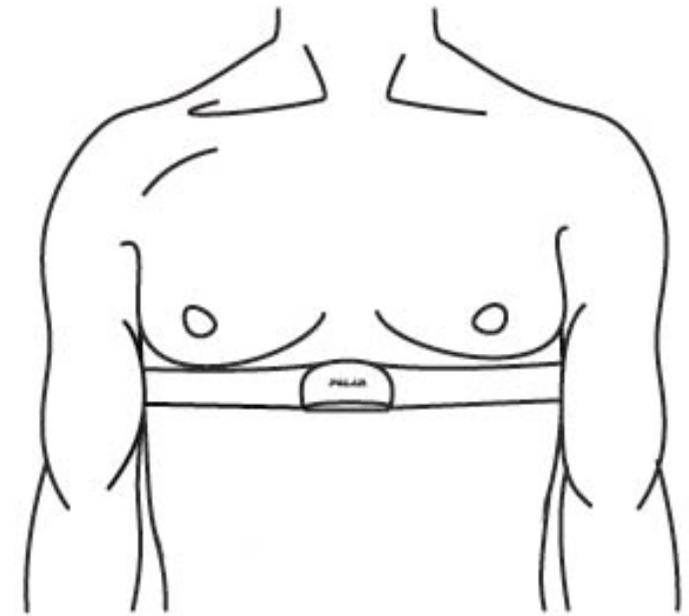
Whilst placing and adjusting the sensor strap. Make sure the GSR sensor strips do not touch. This will short circuit the prototype unit!



**figure 9**

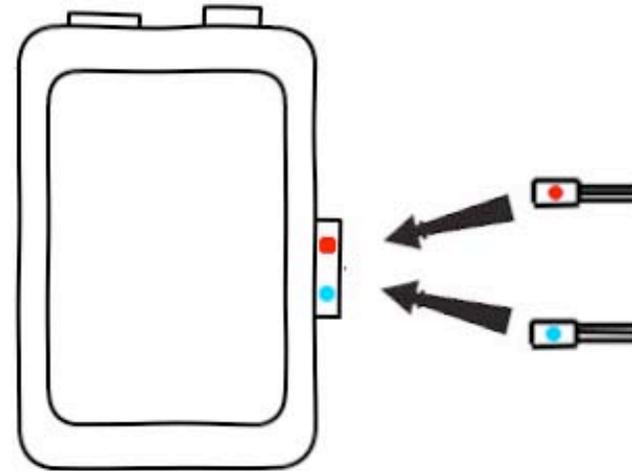
6. Connect the Red Power Cable (2a) to the Prototype unit Red connector.

**figure 8**



7. Connect the BLUE Power Cable (2b) to the Prototype unit BLUE connector.

figure 10



8. Connect the Android phone to the prototype unit with the USB lead. (See system overview diagram)

9. Open the DataLab app on the Android phone. You should see a list of empty text fields.

10. Turn ON the power switch for the prototype unit (3a). The phone will beep and display a USB icon in the top left hand corner of the screen.

11. Immediately you should see the empty text fields replaced by a stream of live data.

12. The Pulse text field will probably display a value of around 0.6. Wait for between 5-15 seconds for the polar transmitter to connect to the prototype unit. Once connected, you will see the Pulse text field data fluctuate to your heart's pulse.

13. After another 5-15 seconds the BPM text field should display your body's BPM data.

14. Take a few deep breaths in and out. Observe the Breathing Rate text field (BR). Although the data will be different for each individual's chest size, the data should change with your breathing. If this is not the case, adjust the sensor straps fit settings, until the desired BR data is achieved.

15. Check the temperature text field (TMP) is displaying data. It may take a couple of minutes to show accurate body temperature.
16. Check the galvanic skin response text field (GSR) is displaying GSR data.
17. The app will display an “Uploading Data (BPM – BR – TMP – GSR)” status when it can connect to a 3G network. When a 3G network is unavailable, it will ignore its upload command.
18. Congratulations, you are now streaming body data!

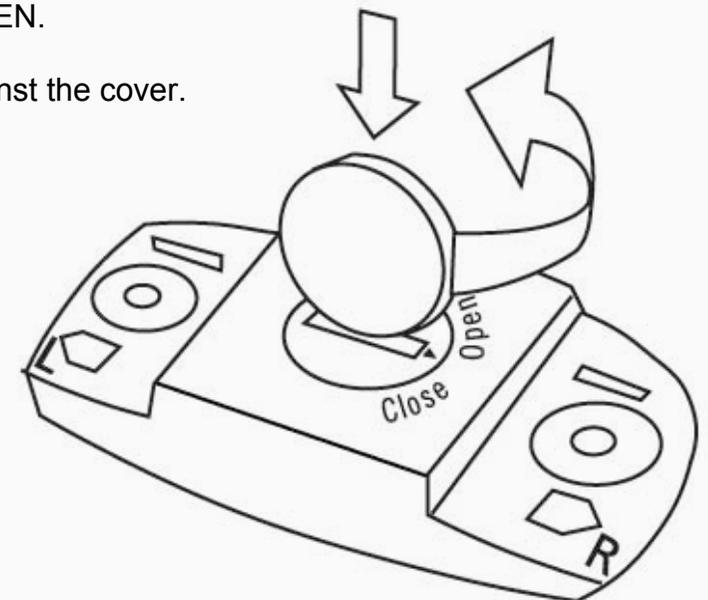
### 3.3. Replacing the Batteries:

Sensor Transmitter Battery:

1. Using a coin, open the battery cover by turning it counter-clockwise to OPEN.
2. Insert the battery (CR2025) inside the cover with the positive (+) side against the cover. Make sure the sealing ring is in the groove to ensure water resistance.
3. Press the cover back into the connector.
4. Use the coin to turn the cover clockwise to CLOSE.

Open the cover only when changing the battery to ensure a long life, and make sure the sealing ring is not damaged, in which case you should replace it with a new one.

**figure 11**



Prototype Unit Battery:

1. When the battery is dead, the USB icon in the top left corner of the phones screen will disappear.

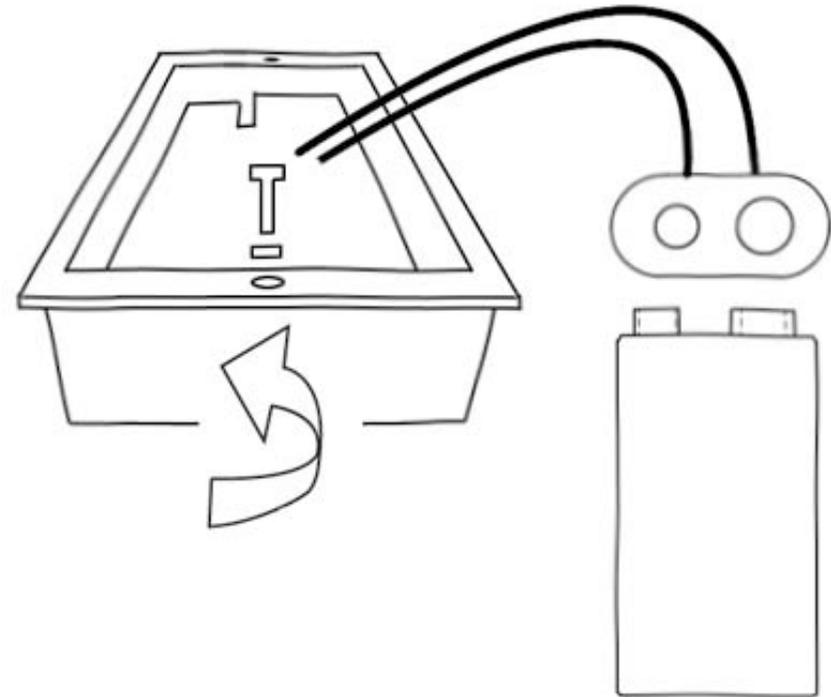
1. Remove the housing cover bolts.

2. Remove housing cover.

3. Gently remove the 9v battery. Be careful not to break the wires!

4. Replace battery

5. Place housing cover back on prototype unit.



**figure 12**

### 3.4. Mindwave headset



The Mindwave headset consists of the headset itself and a Bluetooth dongle. The headset will only work with the dongle and not any other Bluetooth device on the computer. It is important that these are removed or disabled as it can interfere with the setup.

To install the software onto a PC, insert the Application Disc and follow the instructions. It is advisable to install everything.

To install the software onto a Mac, goto:

[http://developer.neurosky.com/docs/doku.php?id=mindwave#installer\\_for\\_mac](http://developer.neurosky.com/docs/doku.php?id=mindwave#installer_for_mac). You will need to install the prerequisite package and then the drivers. Full instructions are given at the above URL.

Insert dongle into a free USB port and put on the headset as per the photo below. Leave the headset turned off for now.

Run Mindwave Manager in the Mindwave Utilities folder and select 'Pairing'. Follow the instructions and when told to, turn the headset on. The software will then pair the dongle with the headset.

To test the connection, currently the best method is to play Blinkzone. If you can 'explode' the fireworks by blinking, then the connection is reliable.

Once the connection has been established and tested, run the Processing Sketch Mindwave Read, and this will collect data on both the Alpha and Theta brainwaves. To activate the trigger the user needs to have their eyes closed and totally relaxed.

To set up a trigger, the condition needs to be mindwave and the value must be set to be less than 10.

## 4. Bio-OS Server

### 4.1. Data Storage Server

The Data Storage Server allows remotely measured bio signal data to be uploaded into the Subject Bio Database. The server supports multiple sensing devices and so allows aggregation of bio data from many different sources (users, devices etc). An open webservice mechanism has been used to create the Data Storage Server so that additional data sources can be easily integrated. In order to store a bio data value in the system, a request must be made to the server for the "store-data.php" page, passing as parameters:

- The id of the subject (person) being sensed
- The name of the bio signal being uploaded
- The millisecond timestamp at which the bio signal reading was taken
- The value of that bio signal

This should take the form of:

`http://server/store-data.php?id=<subject>&<biosignal>@<timestamp>=<value>`

For example, the following request stores the BPM of the subject "dave" at timestamp 1316510004461 as the value 70 bpm:

- `http://server/store-data.php?id=dave&BPM@1316510004461=70`

In the interests of efficiency, multiple data values can be uploaded to the server in a single request by chaining values together with &

- `http://server/store-data.php?id=<subject>&<biosignal>@<timestamp>=<value>&<biosignal>@<timestamp>=<value>...`

For editing triggers:

- `http://79.170.44.128/i-dat.org/datalab/mediator/list-triggers.php`

For storing data value:

- `http://79.170.44.128/i-dat.org/datalab/mediator/store-data.php`

Log of changed data values:

- `http://79.170.44.128/i-dat.org/datalab/mediator/data/username/log.txt`

For example

- `http://79.170.44.128/i-dat.org/datalab/mediator/data/leesphone/log.txt`

figure 13

The server is now common for all users, but we will look into replicating the system for each users.

## 4.2. Trigger Logic Editor

The Trigger Logic Editor allows system administrators (including artist and scientific end-users) to edit the set of rules held in the trigger database. These triggers cause actions to automatically occur when changing bio data values meet particular predefined conditions. For example, an action might occur if a person's heart rate is above 90 bpm and they are in a particular location.

Each trigger has:

- Conditions: when to fire the trigger
- Trigger Actions: what to do when the conditions are met
- Detrigger Actions: what to do when the conditions are no longer being met

### 4.2.1. Guide to writing triggers conditions

The conditions for the trigger are logical triples consisting of:

*parameter comparator value*

For example:

BPM > 70  
GSR <= 15

The current list of available parameters are:

- TMP: the subject's temperature
- BPM: the subject's pulse rate
- GSR: the subject's galvanic skin response
- lat: the subject's current latitude
- long: the subject's current longitude
- BR: the subject's current breathing rate
- id: the subject's unique identifier

The id parameter allows us to create user specific triggers, so that actions can be triggered by the bio data parameters of a particular individual. The id parameter is of the form:

Usersphone

For example:

Hannahsphone

Simonsphone

etc

The following comparators are available for checking parameter values: > (greater than) < (less than) >= (greater than or equal) <= (less than or equal) == (exactly equal to) "Near" (in the same general area as - for use with longitude and latitude). If the proximity of the nearness is not fine (or course grained) enough, this may be tuned internally by administrators.

In order to help test and debug triggers, it is possible to view the current and historical data values for a particular subject. This is viewed by access the subject's log file at a URL of the following form:

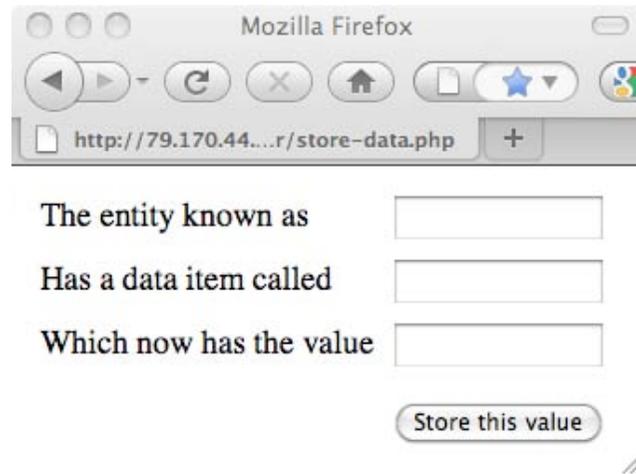
<http://server/data/<subject>/log.txt>

For example: <http://server/data/Hannahsphone/log.txt>

The Trigger Editor user interface is shown in figure 13.

### 4.3. Data Injector

The Data Injector allows bio data readings to be manually inserted into the Data Storage Server through a simple web page. This might be for testing and experimentation purposes, for real time intervention during a live study/activity or simply for the manual storage of non-sensed bio values. The user interface used for injecting bio data into the system is shown below in figure 14.



The screenshot shows a Mozilla Firefox browser window with the address bar displaying 'http://79.170.44...r/store-data.php'. The main content area contains a simple web form with three text input fields. The first field is labeled 'The entity known as', the second 'Has a data item called', and the third 'Which now has the value'. Below these fields is a button labeled 'Store this value'.

The terminology that has been used in the interface has been kept as abstract as possible in order to encompass all possible uses. Webpage style is minimal to keep everything as lightweight and cross-platform as possible.

Example usage:

- The entity known as: dave
- Has a data item called: heartrate
- Which now has the value: 80

figure 14

### 4.4. Trigger Checker

The Trigger Checker compares the current bio data held in the Subject Bio Database with the set of triggers held in the Trigger Database. If the bio data conforms to any of the rules held in the triggers, those triggers are fired and actions occur. The Trigger Checker is invoked on a subject whenever their bio data values change. Conditions checked by the Trigger Checking include both triggered and de-triggered actions.

### 4.5. Gateways

A number of common communication infrastructure gateways have been provided by the framework in order to support integration with other systems. Gateways are provided for Twitter, SMS, Email communications and allow triggers to be created whose actions take place within these domains. In order to make use of these gateways, appropriate values must be used in the recipient ("Send to") field of trigger actions:

- Twitter: Use the keyword "twitter" as the recipient
- SMS: Use a phone number as a recipient (no spaces)
- Email: Use an email address as a recipient

#### **4.6. Pigeonhole Service**

The Pigeonhole service is intended to provide a mechanism for event based communication with external actuators (e.g. lighting systems, door locks etc). Remote systems can request messages for a particular recipient id using the following form:

`http://server/wait-for-messages.php?id=<id>`

For example:

`http://server/wait-for-messages.php?id=lights`

Note: These requests will block until a message is available (or connection timeout occurs).

#### **4.7. Current Value Server**

The Current Value Server provides access to the current bio data values stored in the Subject Bio Database. This allows partners to access live data at any time during operation of the system. The form of requests is as follows:

`http://server/data/<subject>/<biosignal>`

The available data for a subject includes:

- TMP: the subject's temperature
- BPM: the subject's pulse rate
- GSR: the subject's galvanic skin response
- lat: the subject's current latitude
- long: the subject's current longitude
- BR: the subject's current breathing rate

For example, to retrieve Dave's current (last sensed) heart rate value the follow request would be made:

`http://server/data/dave/BPM`

#### **4.8. Live Stream Server**

In addition to allowing the polling of current values, the framework also supports live streaming of timestamped data. This is a

buffered/batched to minimise communication overhead. In order to request a batch of bio data values, the request of the following form should be made:

```
http://server/get-updates.php?id=<subject>&since=<timestamp>
```

Where "since" is a historical cut-off point in milliseconds.

For example, in order to retrieve all of the sensed bio data values for Dave (since the specified timestamp), the following request would be made:

```
http://server/get-updates.php?id=dave&since=1314293710148
```

In response to the above requests, an XML document is returned of the following form:

```
<data>
  <reading>
    <type></type>
    <timestamp></timestamp>
    <value></value>
  </reading>
</data>
```

For example:

```
<data>
  <reading>
    <type>BPM</type>
    <timestamp>1314293859030</timestamp>
    <value>70</value>
  </reading>
  <reading>
    <type>BPM</type>
    <timestamp>1314293901223</timestamp>
    <value>72</value>
  </reading>
  <reading>
    <type>BPM</type>
    <timestamp>1314307286555</timestamp>
    <value>74</value>
  </reading>
</data>
```

</data>

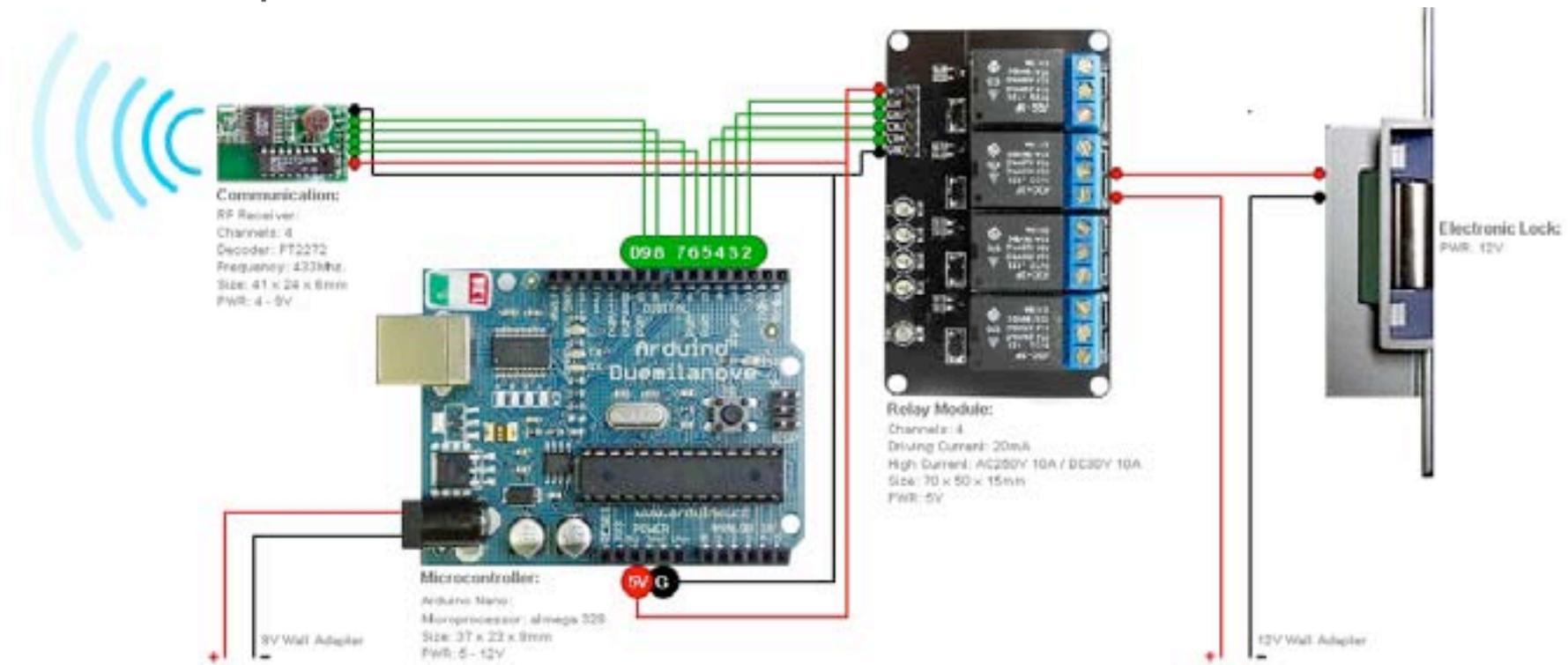
Note: Due to the potentially large amount of data being sent/received, the system will not keep the buffered data indefinitely. Buffered data will periodically be deleted using an intelligent purging mechanism.

## Logging

All incoming bio data values are logged for later analysis and investigation.

## 5. Bio-OS output

### 5.1. Location specific installation



## 5.2. Facebook/Mobile Network/Email

To send a message to Twitter, create a condition as described above and set the “Send to” trigger action to “twitter” with the message you wish to send in the adjoining box. Detriggering the action is the same.

To send a SMS message, create a condition as above and enter the mobile phone number you wish to receive the message into the “send to” box with the message you want to send in the adjoining box. Detriggering the action is similar.

To send an email, create a condition as normal, enter the email address of the recipient in the “Send to” box and the message to send in the adjoining box. Detriggering the action is the same.

## Contact:

### **i-DAT**

Institute of Digital Art and Technology

[ i ] [ > ] [ ... ]

School of Art and Media

Plymouth University,

Drake Circus, Plymouth

PL4 8AA, Devon, UK.

0044-(0)1752 586201

<http://www.i-dat.org>