

eSense Visualiser Application Documentation

Installation and Usage

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1 Application Overview

The node.js application allows to connect to an eSense device and visualise data being streamed from the earbud to a laptop. The application also allows to modify the configuration parameters of the IMU sensor, the microphone and the BLE beacons.

2 Application Installation

The application has been tested on **macOS Mojave (10.14.4)** with **node.js version 8.16.0** and **npm version 6.4.1**. Please make sure you are using the same versions of the software to run the application. To run the application on Windows it might be required to change some of the packages.

Follow these steps to install the application on macOS:

1. Install node v8 (we recommend using Brew) and verify the versions

```
$ brew install node@8  
$ node -v  
$ npm -v
```

2. Unzip the application folder
3. Go to the folder from the terminal and install all the libraries with

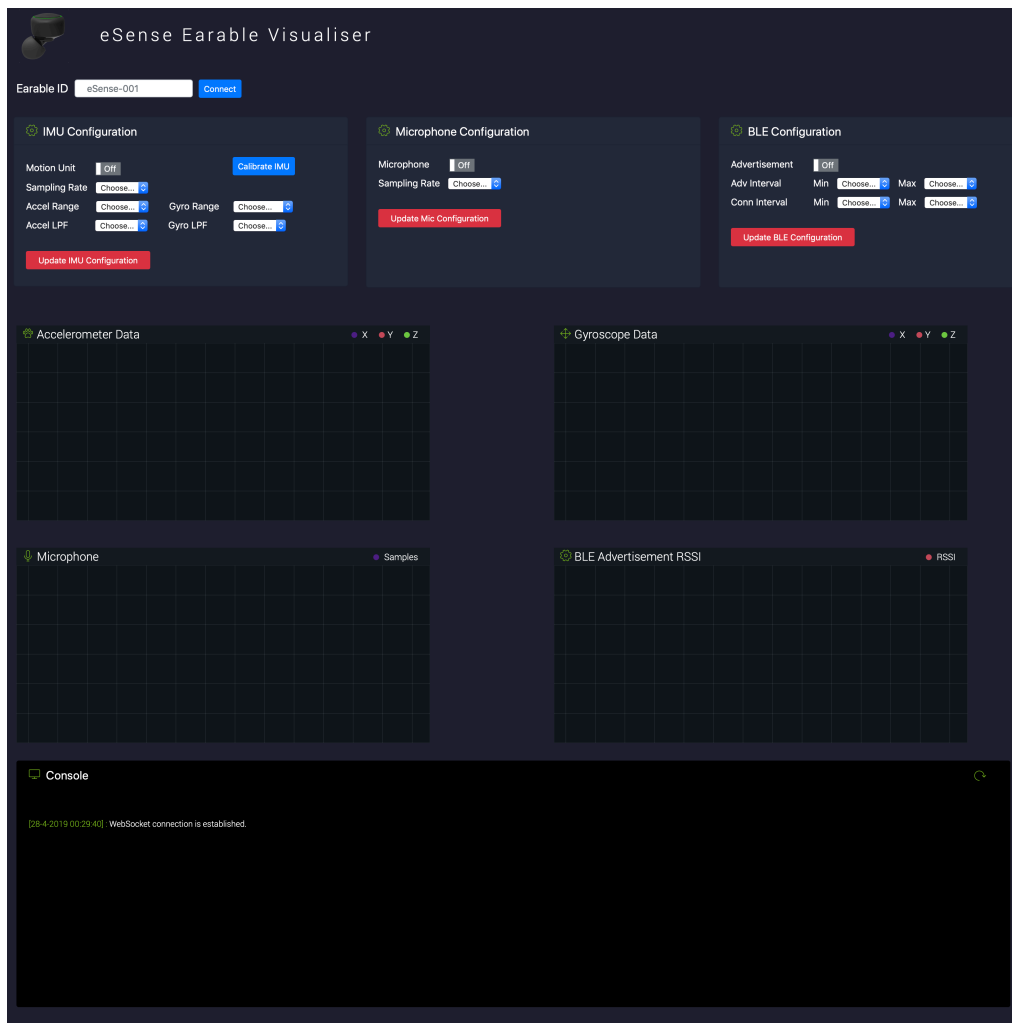
```
$ npm install
```

4. Run the application with

```
$ node index.js
```

5. Navigate to <http://localhost:5000/> from a browser to open the user interface

3 Application Usage



At the top of the UI there are the controls to connect to an earbud identified by its name (left earbud) and to configure various aspects of the device. You can find the name of the earbud using a BLE scanner app (e.g. Nordic nRF Connect). Below this there are the visualization panels which display data from the IMU, from the microphone and the BLE packets transmitted by eSense. At the bottom of the page a console will show status messages about the application and the eSense device.

Before using the application pair the right earbud to the laptop by going into the Bluetooth Preferences and enabling pairing mode on the earbud (long press of push button). This way the microphone data will be sampled from the right earbud by default.

3.1 IMU Configuration

This section allows to start the IMU sampling with a certain sampling rate and configure the IMU. You can change the accelerometer and gyroscope full scale range which defines the minimum and maximum acceleration and rotational speed detected by the sensor. It is also possible to enable the onboard low pass filter for accelerometer and gyroscope. In the two dropdown lists you can specify the bandwidth of the filter or disable it completely. For more details about the IMU configuration please refer to the **eSense BLE Specification** document.

3.1.1 Calibration

IMU sensors, the gyroscope in particular, typically present a bias in their readings. This application allows to calibrate eSense and compensate for the bias. In order to find the bias the earbud needs to be completely still and positioned in a known position. To achieve this place the earbud in the charging case upside down, as shown in the figure(make sure it is facing down). Then start the calibration by pressing the button in the UI. When the calibration completes you will see messages in the console displaying the bias value for each axis. These values are automatically applied to the IMU data next time the IMU sampling is activated.



The technique we use to calibrate the IMU is quite simple and more sophisticated methods exist. Essentially we collect 200 accelerometer and gyroscope samples when the earbud is in a known position and then take the average of the values for each axis. This gives the offset that has to be applied to each axis in order to have the appropriate readings: gyro X,Y and Z very close to 0 when the earbud is still and accelerometer X = 0, Y = 0 and Z = -1 when the earbud is facing down.

3.2 Microphone Configuration

From this section the microphone sampling can be enabled, selecting a desired sample rate. The application will use the system's default input source (e.g. laptop's built-in microphone). Therefore, make sure to pair the right earbud with the laptop so that the audio will be sampled from eSense.

3.3 BLE Configuration

eSense transmits periodic BLE beacons which can be received by the laptop. The BLE Advertisement panel shows the RSSI of these packets when the scan is enabled on the laptop. From this section it is possible to select the min and max values used by eSense to transmit BLE beacons. If you do not see many packets in the RSSI panel try reducing the advertising interval. The application will take longer to find the earbud if a large advertisement interval is used.

This section allows also to change the connection interval used by eSense. The connection interval affects the rate of the data exchanged between eSense and the laptop. Make sure to disconnect and re-connect to eSense to make the new parameters (advertisement and connection interval) effective.