Datalogging tools

Application Board 3.0 based datalogging tools

Datalogging tools Application note

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1 Introduction

Sensor data acquisition and logging is essential to use-case and algorithm development. In addition, synchronized data acquisition from multiple devices simultaneously allows to explore use-cases like body area networks and equipment monitoring.

The Datalogging tools allows for,

- creating datasets, adding subjects/objects and other metadata
- selecting and configuring the sensors
- creation of custom label and triggering them during logging
- start and stop logging of the sensor data and incorporating the data log into a dataset
- downloading the logged sensor data
- navigating and visualizing selected logfiles, including metadata
- logging sensor data from multiple devices

The hardware of the datalogger consists of the Application Board 3.0 and a Shuttle Board 3.0 of the sensor, whose data is of interest. The main components of the Application Board 3.0 are the BLE SoC which acquires data from the sensor and manages the communication through BLE with the Android app. In addition, the on-board external NAND flash is used to store the sensor data in a binary format.

The software, apart from the firmware which runs on the BLE SoC consists of an Android app which acts as a User Interface to control the various aspects of the data logging process. In addition, the toolkit ships with a Python script that converts the binary data format into a CSV file for an easier import into conventional data processing tools. This script can be modified to export the data into a preferred data format.

Table of Contents

List of figures

2 Board and software setup

2.1 Pre-requisites

- The Application Board 3.0 flashed with Datalogger firmware along with a supported Shuttle board 3.0.
- The Application Board 3.0 can be powered via USB or by a single cell Lithium Ion or Lithium Polymer battery.
- An Android phone (Android 8.0 or newer) installed with BST Datalogger Android application.
    - Note: The Android device should support an MTU packet size of 243.
    - Note: Only the Google Pixel 2 and One Plus 6 have been thoroughly tested.
- A system running Windows 7 or 10 operating system. The system should provide a USB 2.0 interface. This is required to copy logged data from the device to system.

2.2 Setting up the hardware

It is recommended to use an ESD safe environment to operate the Application Board 3.0 as depicted in the image.

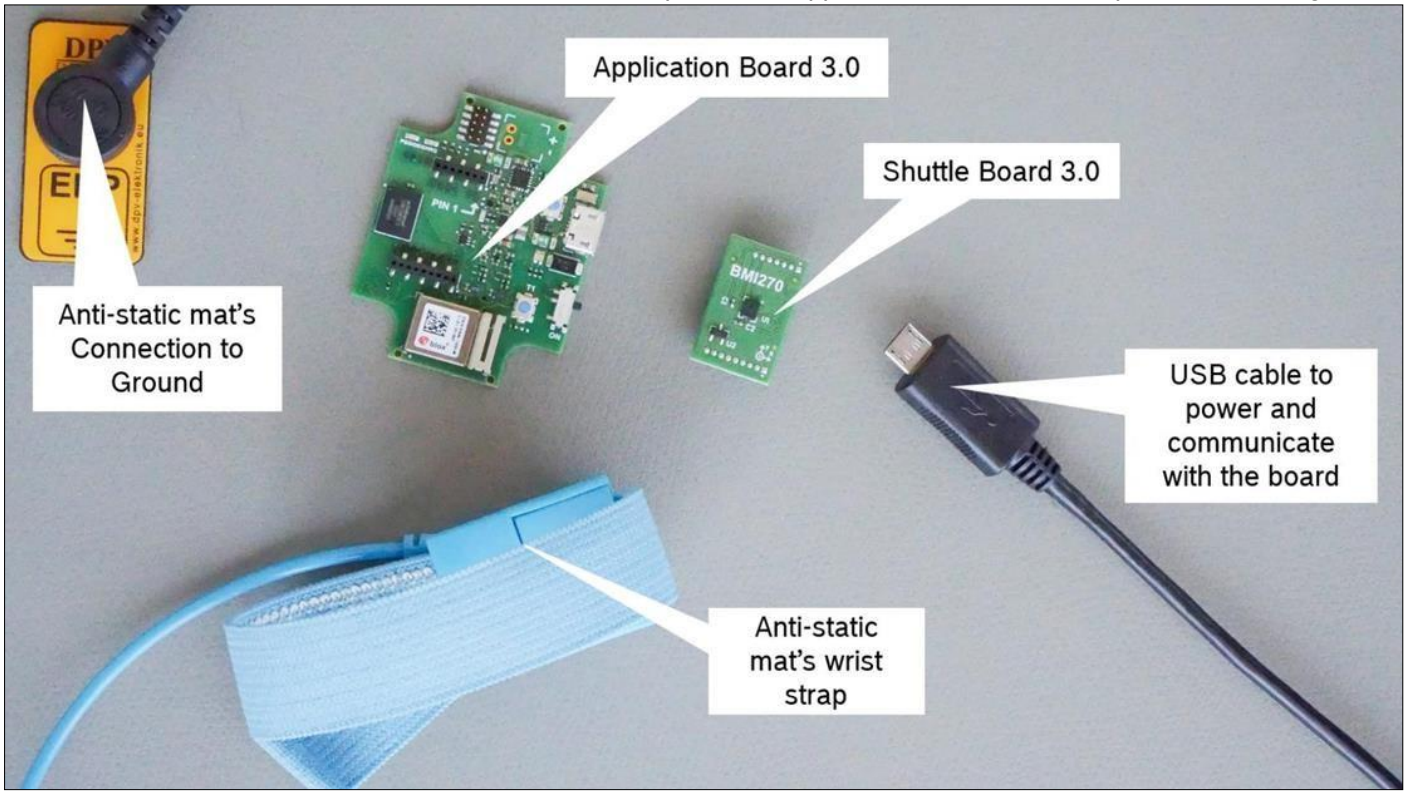

Figure 1 Application Board 3.0 Setup

2.2.1 Connecting a Shuttle Board 3.0

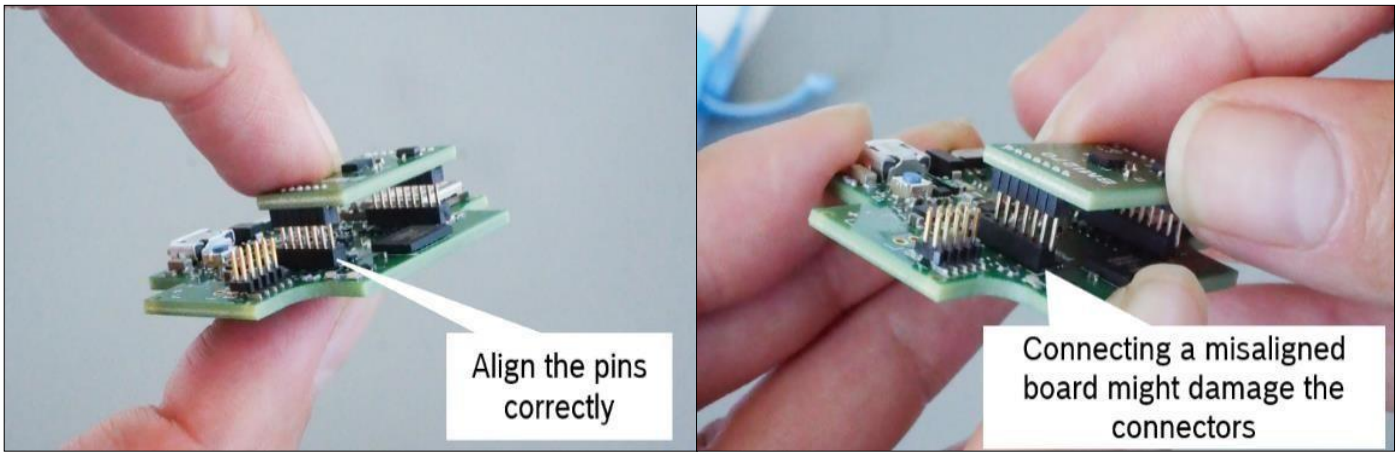

Figure 2 Aligning the pins of the Shuttle Board 3.0

Once aligned, press down on the board with both thumbs to fit the Shuttle Board 3.0 onto the Application Board 3.0.

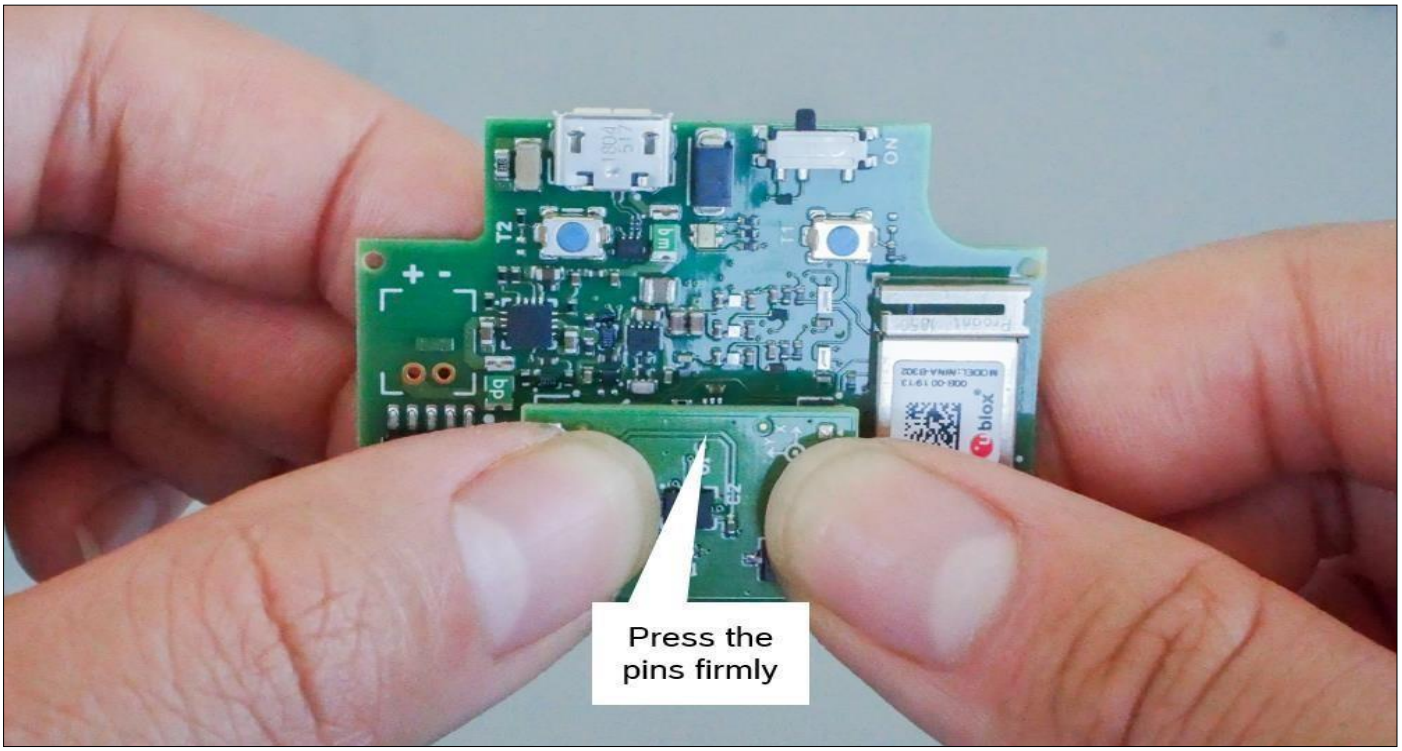

Figure 3 Connecting the Shuttle Board 3.0

2.2.2 Connecting a Shuttle Board 3.0 board using USB

Before connecting the USB cable, ensure that board is switched off.

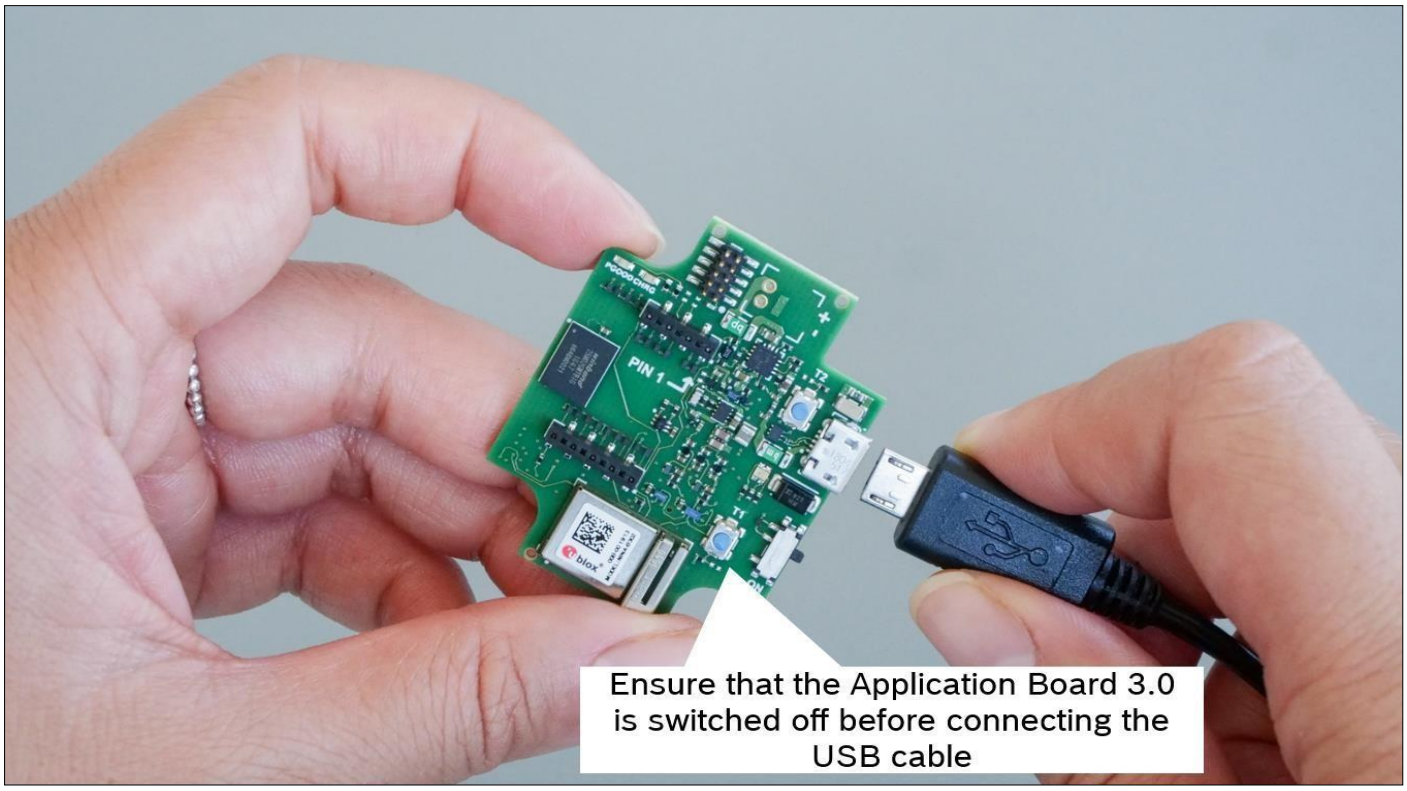

Figure 4 Connecting the USB cable

2.2.3 Powering on the Application Board 3.0

To power on the board slide the main switch into the ON position.

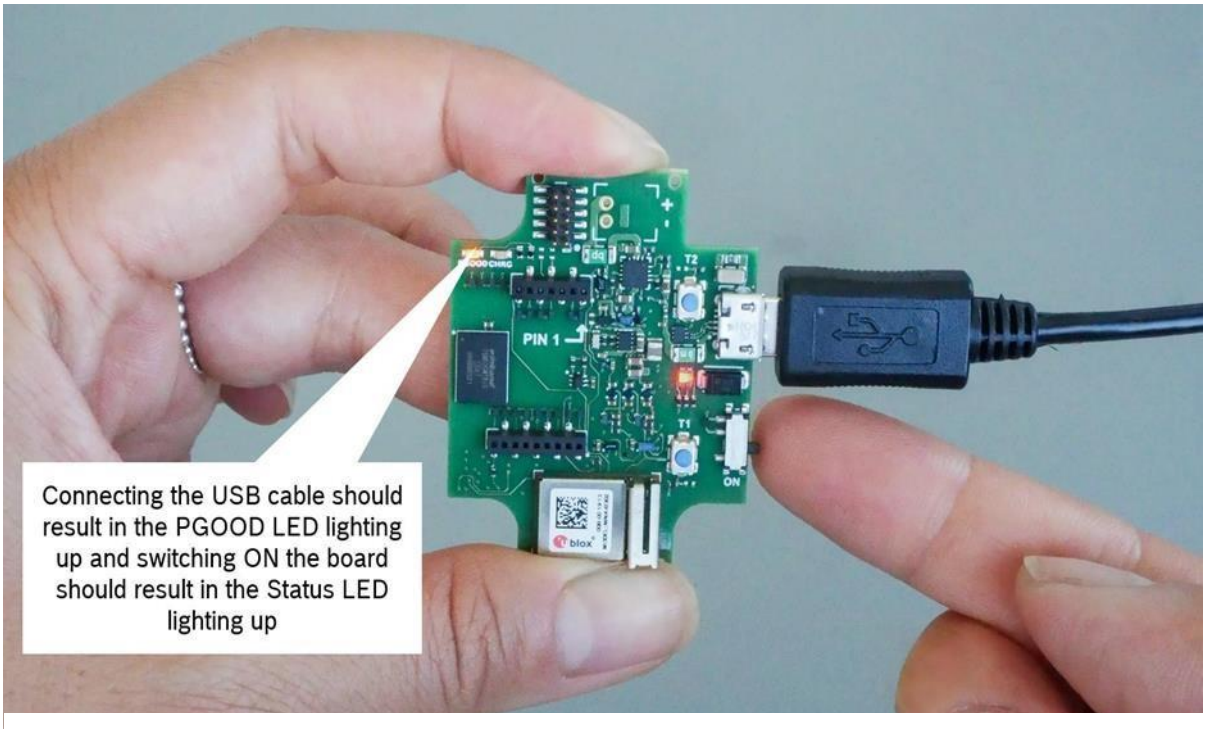

Figure 5 Switch on the Application Board

2.3 Firmware update

The stock firmware programmed on the boards is meant to operate with the Development Desktop 2.0. However, to log data from the sensor without the need of a USB cable, the Datalogger firmware needs to be downloaded. The Datalogger firmware for the Application Board 3.0 is released as part of the COINES installer. The firmware can be downloaded to the device using the USB-DFU bootloader. The USB-DFU bootloader comes pre-programmed on the Application Board 3.0.

- To enter the bootloader mode, press and hold the button T2 and start/restart the board using the power switch. The LED should turn to a solid blue.
- In the COINES installation directory, under *datalogger\Binary* Drag and drop the *BST_Datalogger.bin* file onto the *download_to_flash.bat*. This action triggers the firmware download onto the Application Board 3.0.

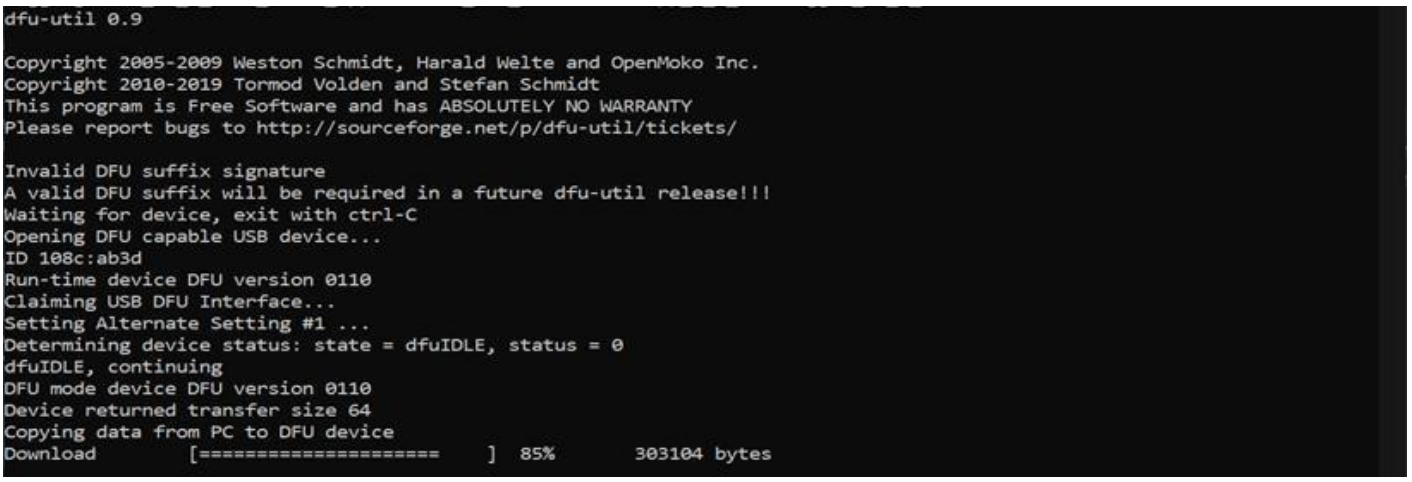

Figure 6 Firmware download via the bootloader in progress

2.4 Setting up the Android app

As of this release, the Android app is not available via Google Play store. Hence, the *BST_Datalogger.apk* is shipped as part of the COINES installer in the *datalogger\Apk* directory.

Note: If the app was already installed, uninstall the existing app and delete the files from the internal storage of the phone before proceeding.

- Copy the APK into the internal storage of the Android phone
- From the Android phone, navigate to the folder where the APK is stored using a file browser app.
- Android will ask you to grant permission to the file browser app to install the APK. Granting permission should forward you to the installation screen. If not, navigate back and try again.

3 Getting started with the datalogger

3.1 LED notifications

- The red LED blinks when the device is switched ON, idle and waiting for a connection.
- The green LED indicates sensor data being logged.
- The blue LED indicates file streaming to the phone.

3.2 Using the BST Datalogger app

Open the installed BST Datalogger app. After opening it, the app will direct you to the Dataset Explorer page. The first thing to do is select a dataset.

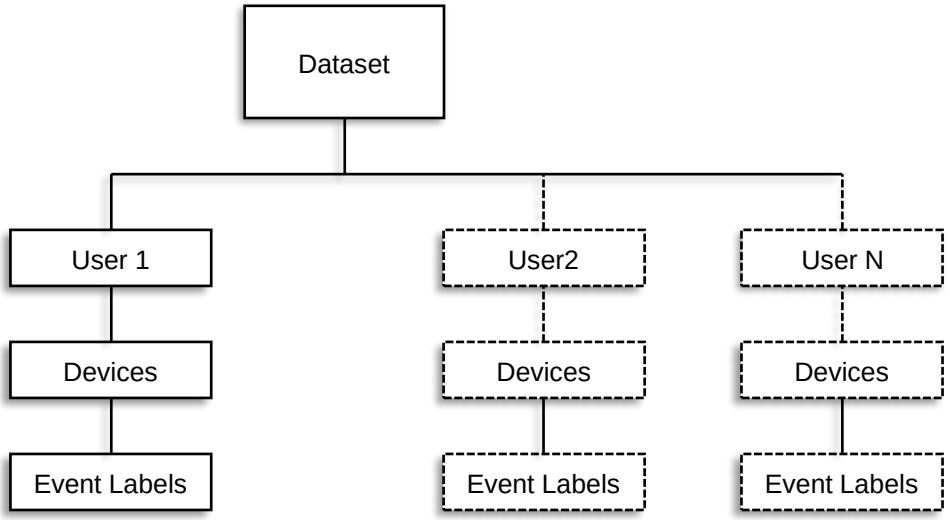

Figure 7 Datalogger flow overview

3.2.1 Creating a dataset

A new Dataset can be created by pressing the **Add Dataset +** button in the top right corner of the screen. Fill in the Dataset name and Description. The Dataset name defines the purpose for which the data collection is made, and description explains about that dataset. When done, click **Create** button, select the created dataset and click Submit button.

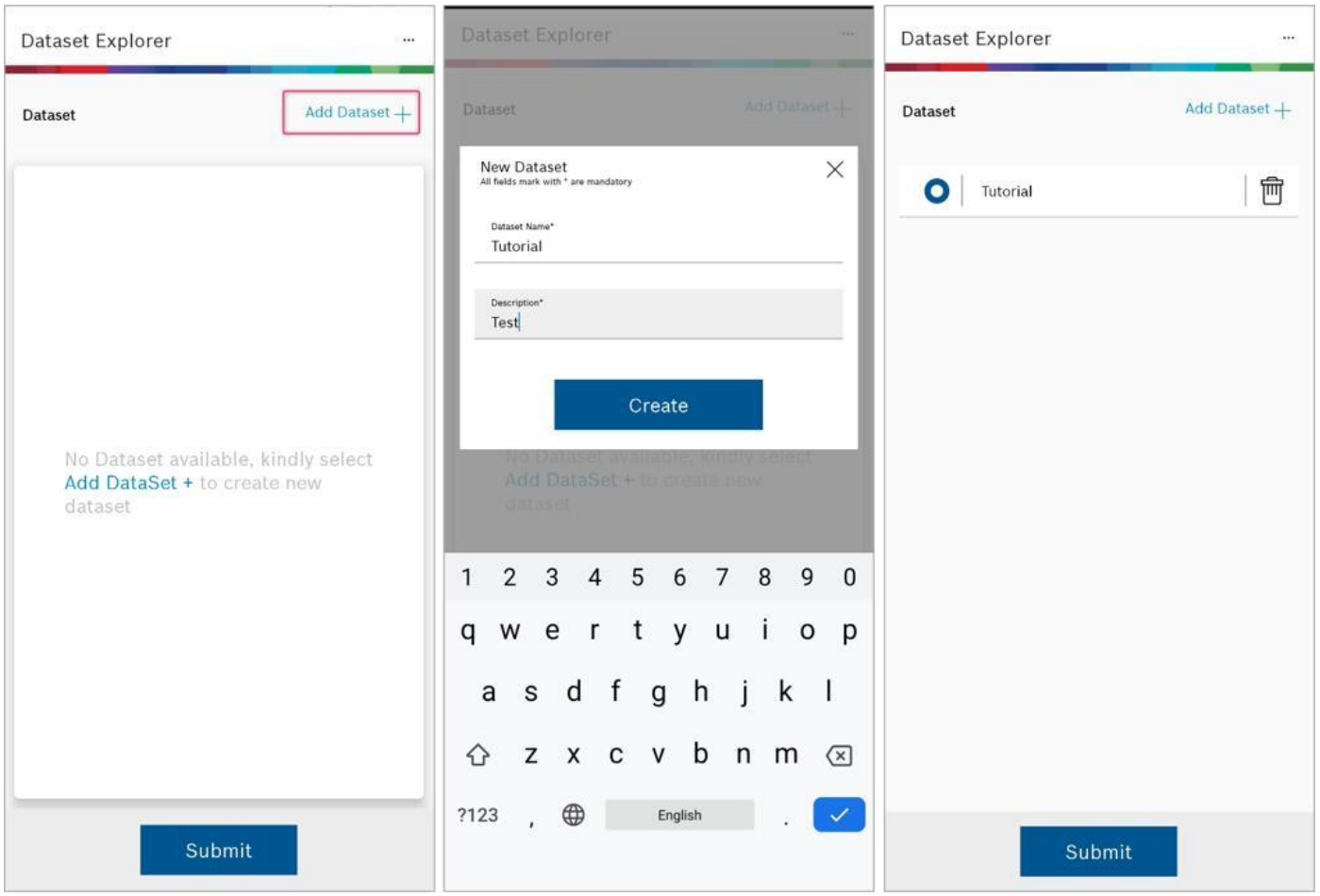

Figure 8 Creating a dataset

3.2.2 Adding users

The next is page is the Dataset Details. Here the User's details need to be added. A User in this context is a person who is operating the datalogging device. A new User can be added by pressing **Add User+** button. Now that you are in the User Settings page, the user should add a name and any other meta data that might be required. After entering the necessary meta data, you can proceed by selecting the Submit button below.

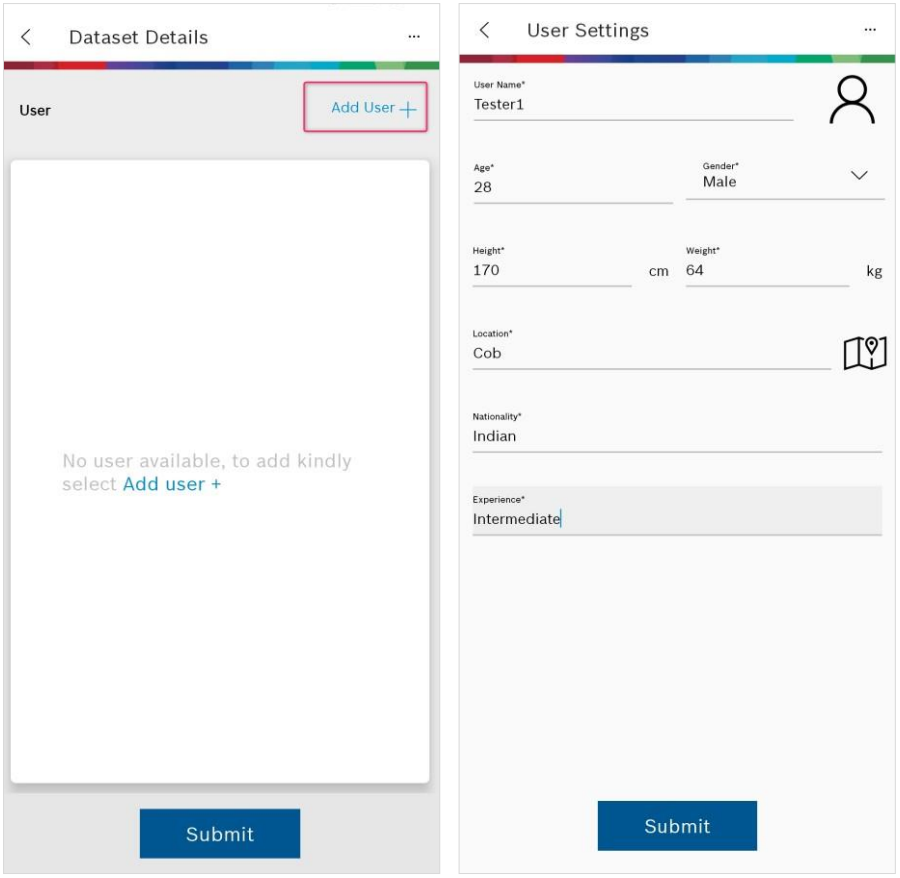

Figure 9 Adding a User

3.2.3 Adding Event Labels

Once in the main page, the global list of Event Labels is visible. From this set, a User can select labels that are needed for a specific log, refer 4.2.6 for more information. If the already present Event Labels are insufficient, new Event Labels can be defined by selecting the icon. When adding a new Event Label, ensure sure that the format is aligned with existing event, i.e. All capital letters and underscores for space. The newly added Event Label should be visible from the

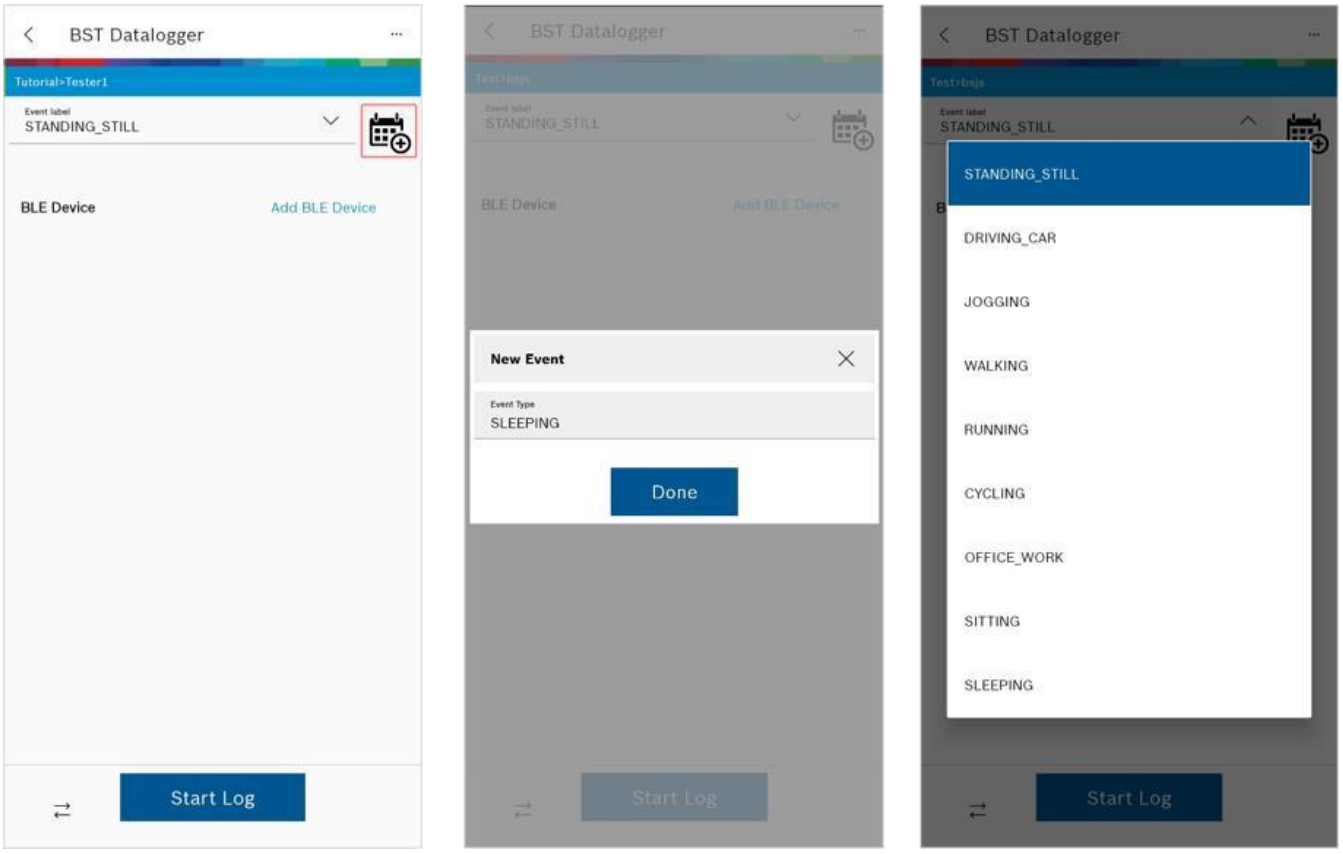

Figure 10 Viewing and Adding Event Labels

3.2.4 Pairing with one or more devices

The next step is to add compatible Bluetooth LE enabled devices. Select the **Add BLE Device** option, which opens a window showing the various compatible devices visible. Note that Bluetooth and Location permissions need to be provided to the app. The App3.0 board advertises with the name **BST-DataLogger**. If you cannot see the device, you can stop and start the scan again. Selecting the device to pair will take you back to the main page. Now you can see the device name and details once paired. This step can be repeated to pair multiple devices.

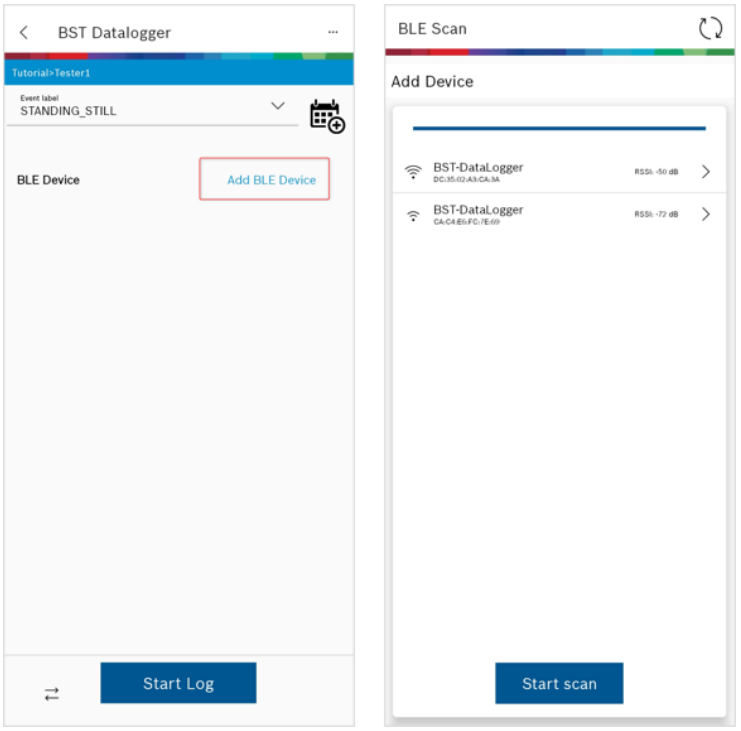

Figure 12 Pairing with a compatible device

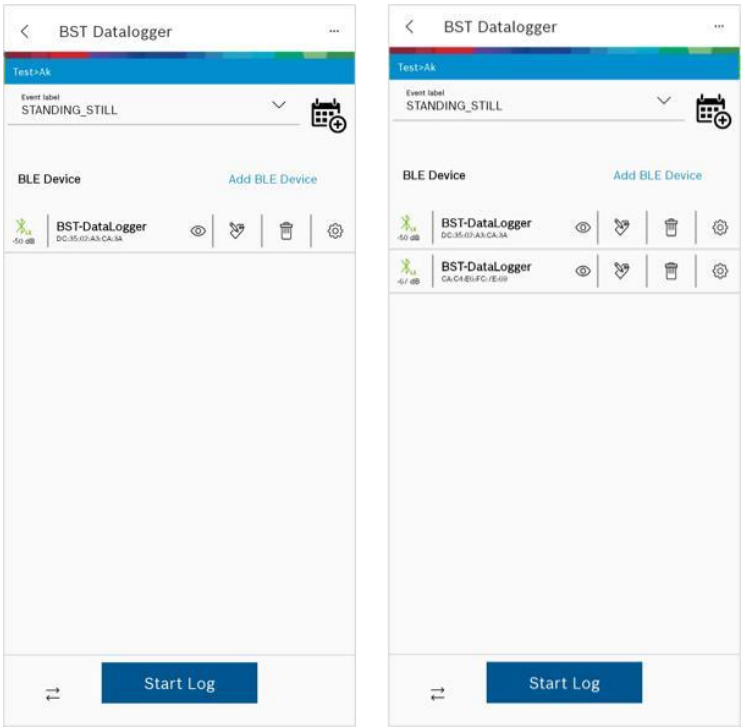

Figure 11 Pairing with multiple devices

3.2.4.1 Removing a device

To remove a device, click the button of the respective device. Confirm the removal of the device.

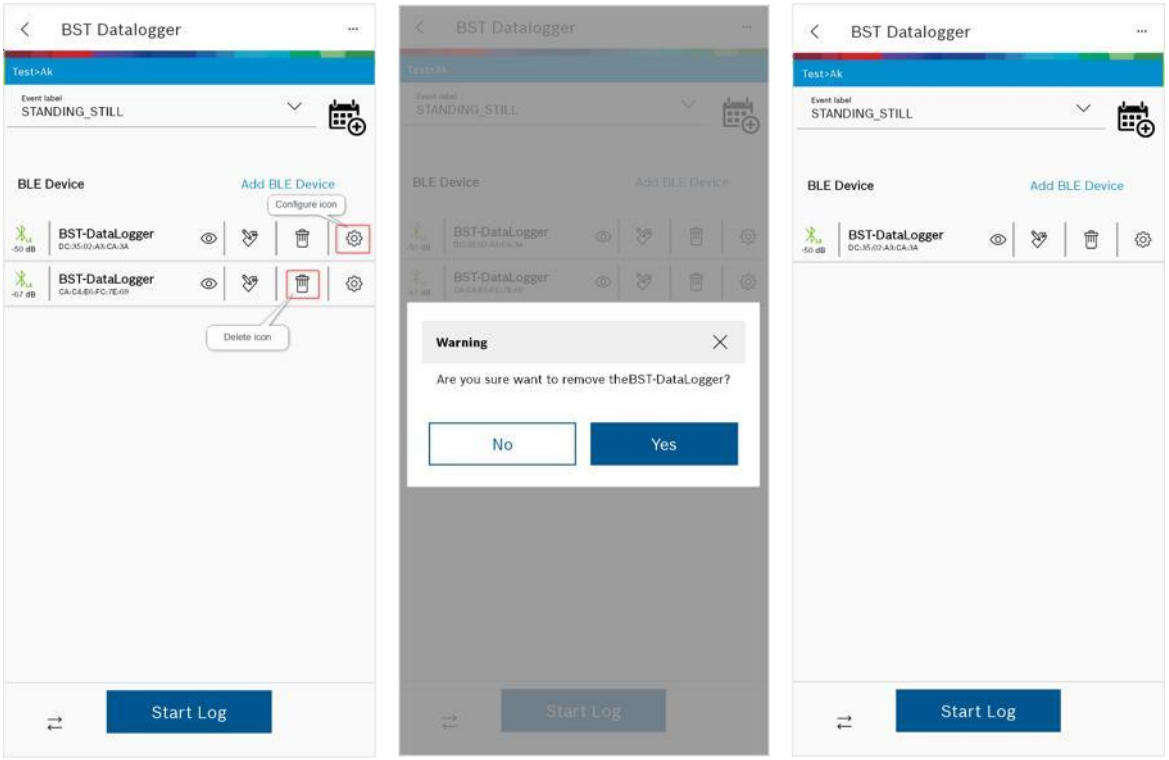

Figure 13 Removing a device

3.2.5 Configuring the device

Selecting the icon, directs you to the device overview page of that device.

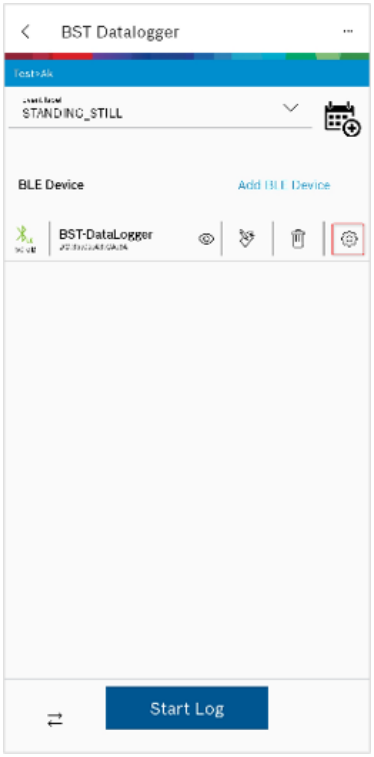

Figure 14 Device configuration

3.2.5.1 Configuring the device position

As part of the device configuration page, the device position and available sensors are visible. In addition, the Event Labels relevant for this device can be selected from the global list of Event Labels. The device position is used to define how a device was mounted on the human body.

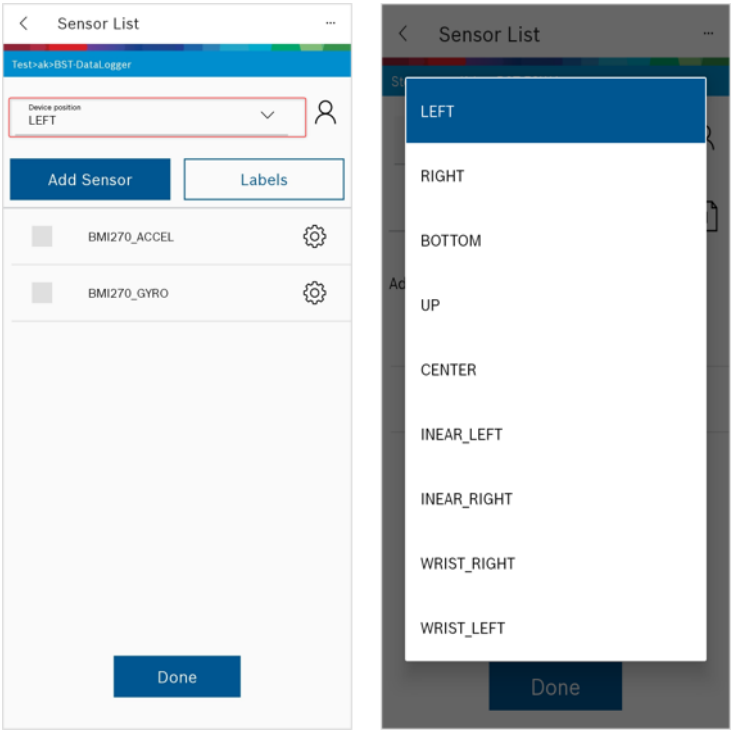

Figure 15 Selecting the device position

3.2.5.2 Configuring the Sensor

Select the sensors whose data needs to be logged under the **Add Sensor** button. Configure the necessary sensor parameters by selecting the ⚙ beside the specific sensor.

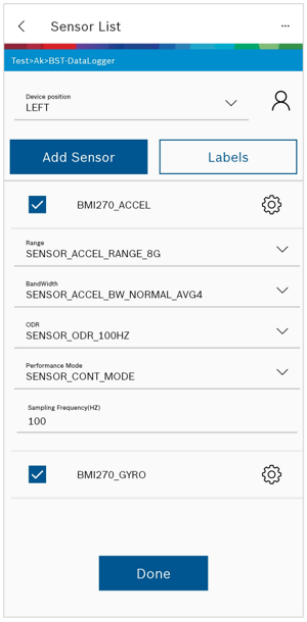

Figure 16 Sensor configuration

3.2.6 Configuring Event Labels

Click the **Labels** button in Sensor List page to enter the label window. To add labels to the log, select the **Add/Remove+** icon. After entering the label name and ID the type of Event Label can be set to either a start/stop (state based) label or a trigger label. The former is suitable for prolonged activities such as walking/running etc., to mark the start and stop time of the activity, while the latter is used for shorter events such as tap sensing. Complete the configuration by selecting the **Add** button. Multiple labels may be added to a single log. The same steps can be followed for setup with multiple device connections.

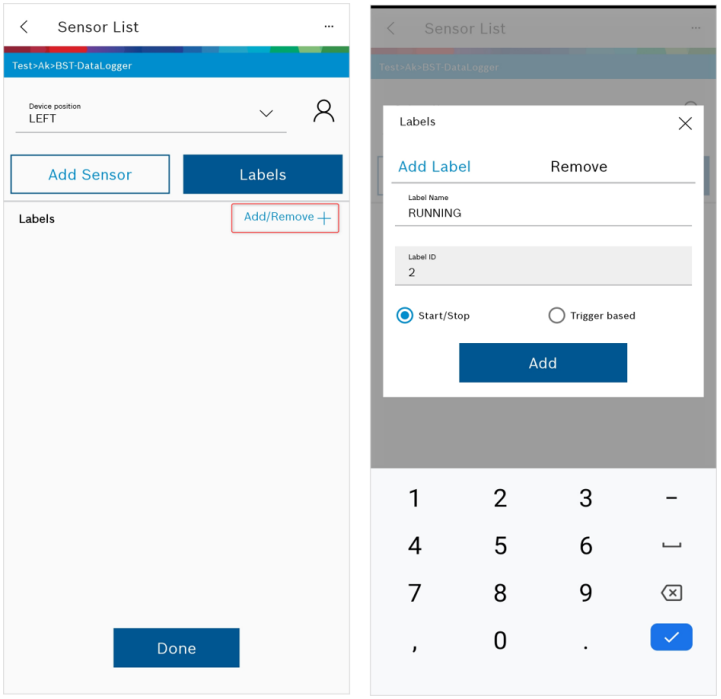

Figure 17 Adding and configuring Even Labels

An Event Label may also be removed by selecting the Remove tab and subsequently selecting **Remove.**

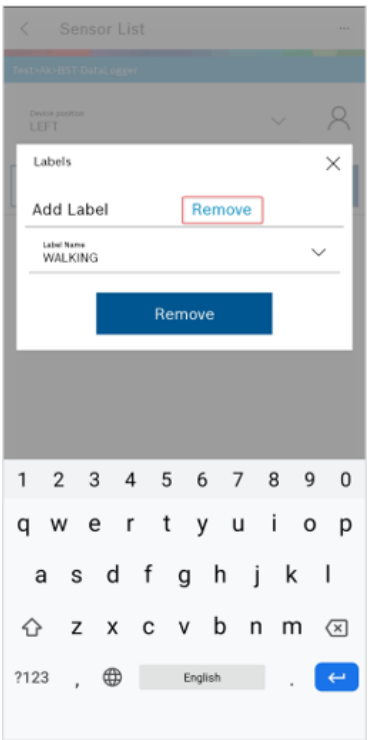

Figure 18 Removing Event Labels

3.2.7 Selecting Event Labels

Select the required Event Labels needed for the log and select **Done** to proceed to the main page. Now the all the configurations are complete, selecting the will list all the selected Event Labels.

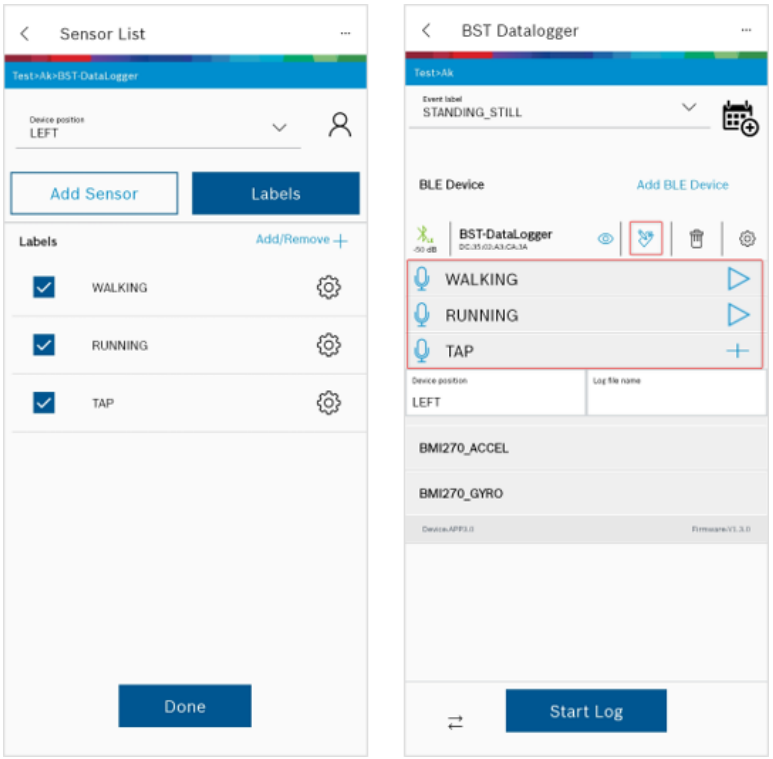

Figure 19 Selecting Event Labels

3.2.8 Start Data logging

Selecting the **Start Log** button triggers logging of data. If successfully, the button should change to **Stop Log.**

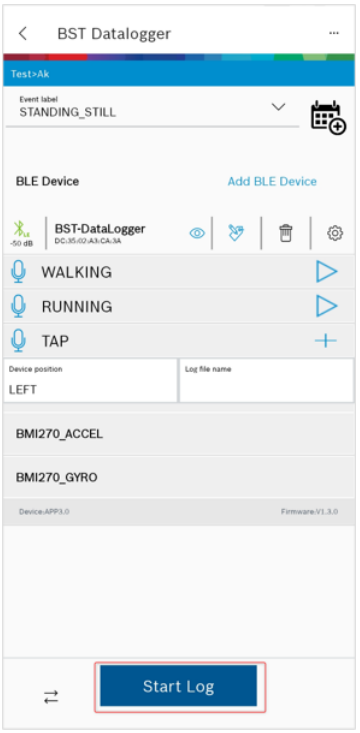

Figure 20 Start logging

3.2.9 Triggering Event Labels

While data is being logged, Event Labels can be triggered to annotate the data in real-time.

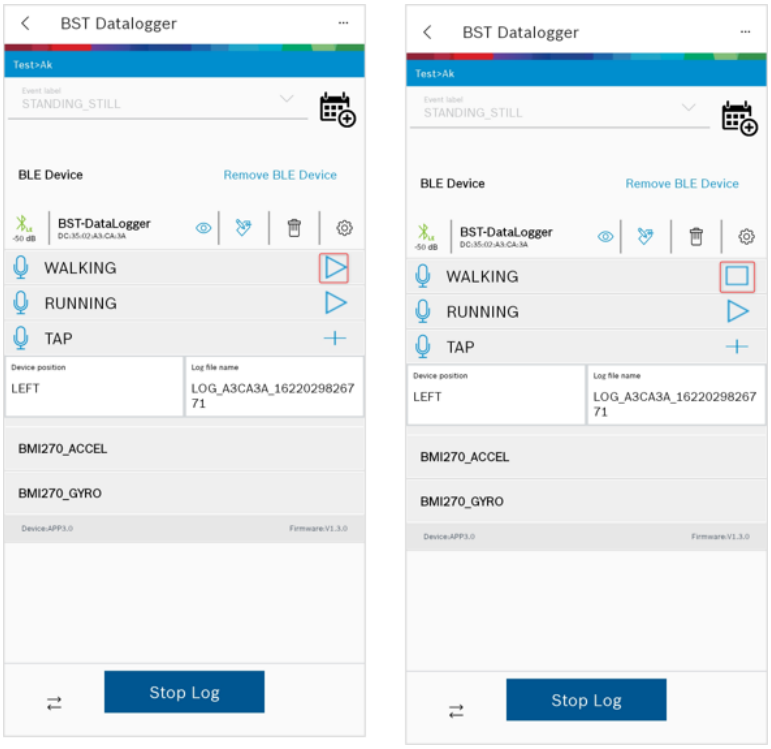

Figure 21 Using Event Labels while logging

3.2.10 Stop logging

Selecting the **Stop Log** button terminates the logging of sensor data. To summarize the log and to add any further notes, a pop-up appears to provide a text box for the same.

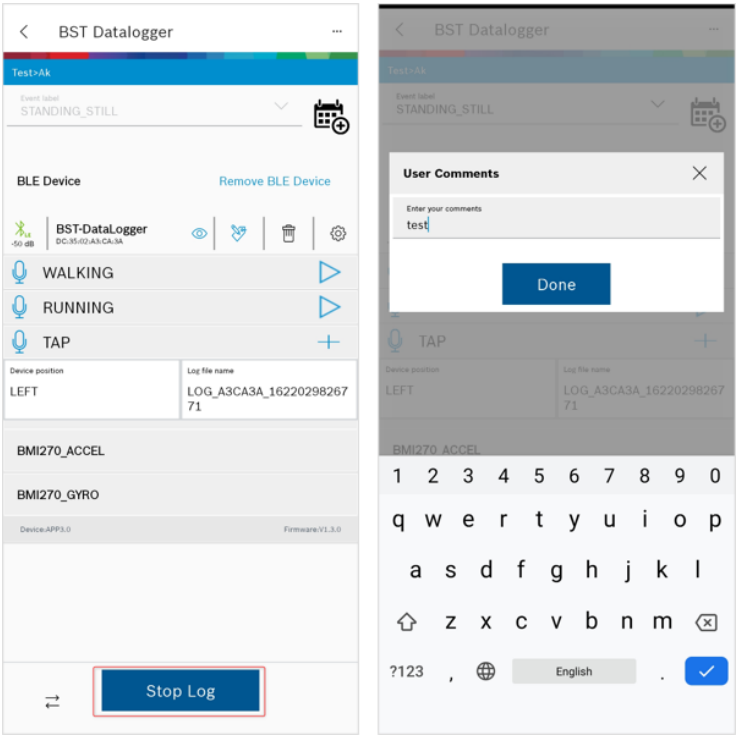

Figure 22 Stop logging and Log summary

On selecting BST-DataLogger DC:35:02:A3:CA:3A a device, the unique file name for the data log can be viewed. The collected sensor data will be stored on the external flash chip of the Application Board 3.0 with a filename using the format “LOG_<Last 3 bytes of the device MAC ID in Hex>_<UNIX timestamp>”.

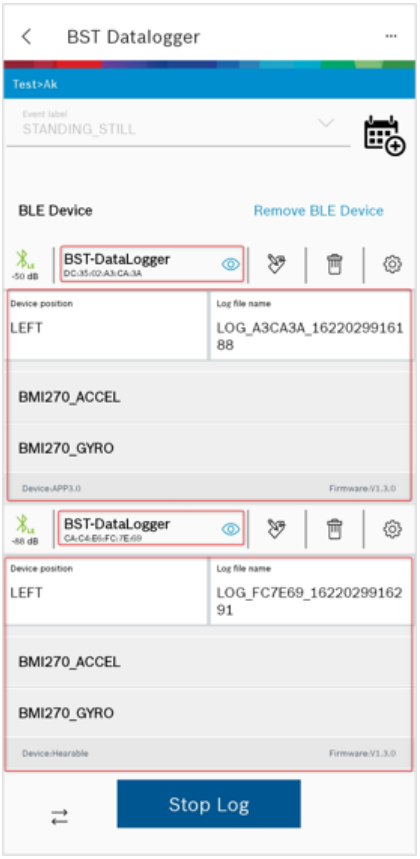

Figure 23 Post-log overview

3.3 Downloading sensor data

Sensor data and meta information about the dataset are stored on Application Board 3.0's memory and the smartphone's internal storage respectively.

3.3.1 Dataset description

A dataset folder contains logfiles and meta information. It can be found in phone's storage under **storage/BST_Datalogger/Dataset/location**.

Figure 24 Dataset folder overview

- 00_meta folder - Contains meta information about the dataset, user and acquired activities and ground truth
  - datasetInfo.json - Dataset name, description, date of creation
  - userInfo.txt – User's information: name, age, height, weight, id etc.
  - activity.txt - Contains information about the event activities for log files
  - algoResults.txt – Currently reserved
  - fileInfo.txt - Description of the log files within the dataset.
  - deviceConfig.json - Devices and sensor logging configurations
- 01_data
  - bin – Contains binary log files
  - csv – Contains CSV data files (converted from binary)
  - labels - Contains labelled files with start and stop time of labels for respective logs
  - plots - Plots of the logged channels for every log file within the CSV folder
- 99_configs – Contains a list of device locations and activities

Copy the Dataset folder from the phone to a PC, to run the data log decoding script. Note that even if the recorded data doesn't belong to the current data set, the data log is copied into the currently accessed data set. However, the meta data and labels are only stored in the corresponding folders i.e. if one downloads the data that does not belong to the current dataset, then the labels and other associated information of the downloaded data cannot be found in the subfolders 'labels' and '00_meta" of the current dataset folder. In order to match the binary file containing the sensor

data and associated metadata, one must manually move the .bin file into the right dataset folder. The same is true for when the file is downloaded directly from the device to the PC.

3.3.2 Copying of sensor data

Sensor data can be copied in two possible ways.

3.3.2.1 Copying data using a PC

Connect the Application board 3.0 to the PC. The Datalogging application enumerates over USB as an MTP device. This method is best suited for large files as copying data logs to the phone over BLE will take significantly longer.

- Connect the Application Board 3.0 using USB cable to PC
- The device will enumerate as an MTP device with name “App3.0 Board". Click on it and select the “W25M02 External Memory"
- The device will list all the available files and all required files can be copied

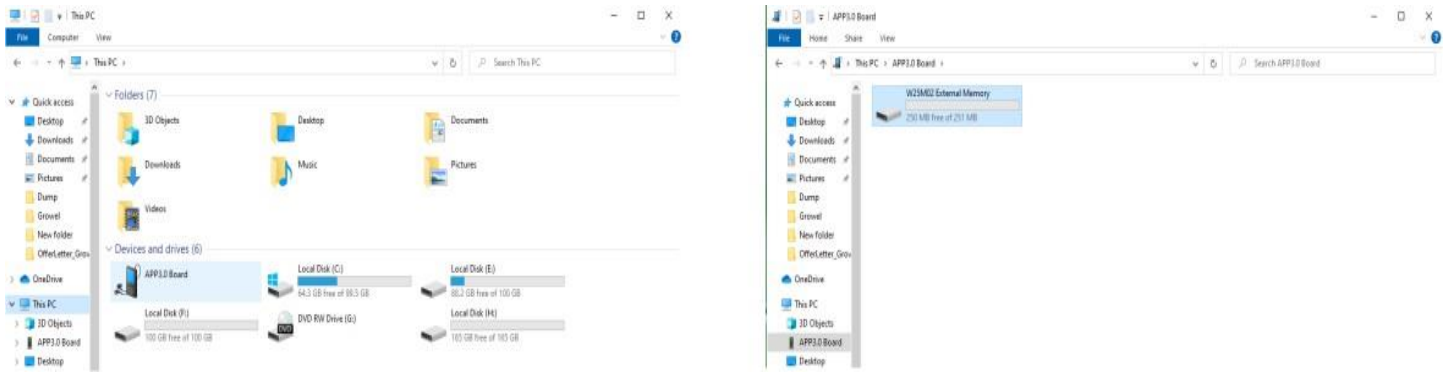

Figure 25 Copy data log files to the PC over USB MTP

3.3.2.2 Copying data using an Android Phone

In order to copy data from the Application Board 3.0 to the phone over BLE, in the BST Datalogger android application, select the ⇄ icon to switch to the read mode and confirm by selecting **Yes**.

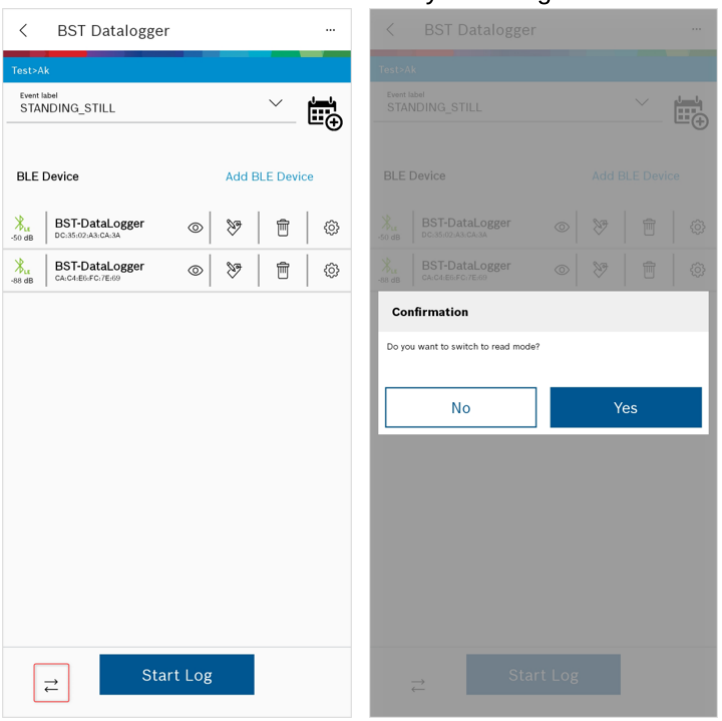

Figure 26 Entering BLE read mode

Once in the read mode, only the 5 most recent files of first device will be listed. To toggle between devices, tap the device name and select the device for which file must be downloaded.

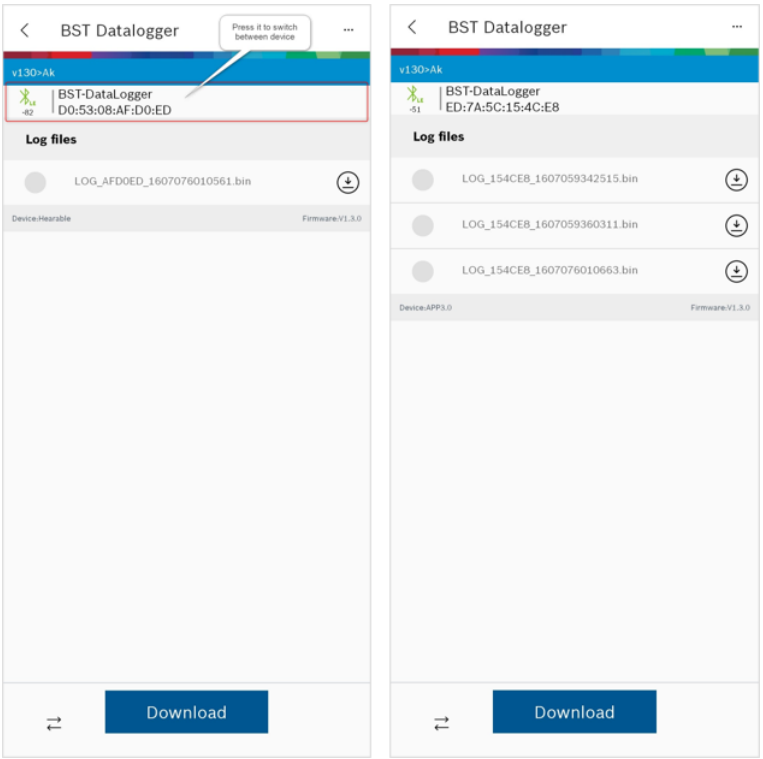

Figure 27 Choosing a device to copy files

The User can select the required files and select on the **Download** button. Once the file has been downloaded from the device, the ‘download icon’ of the file that has been downloaded will turn light blue to indicate that this file has already been downloaded to the phone.

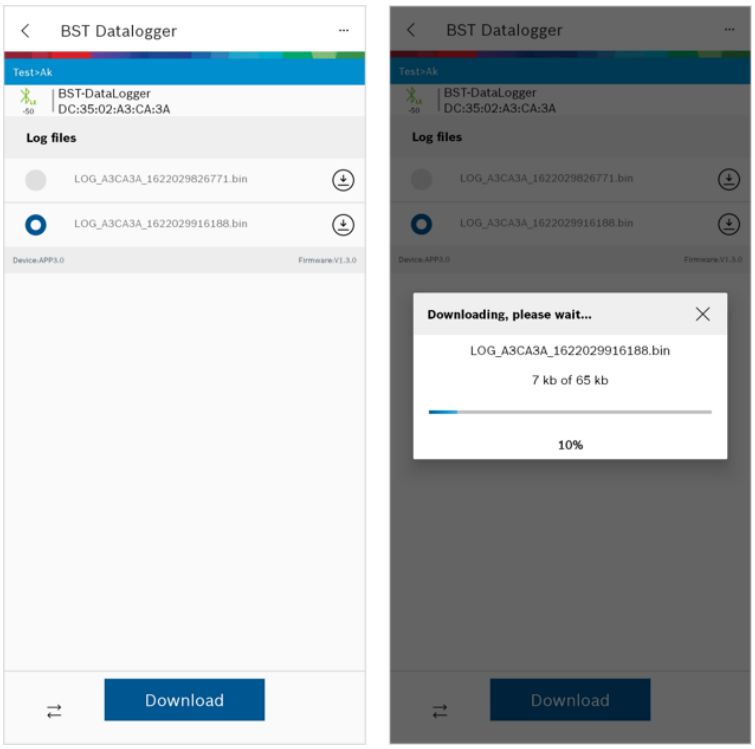

Figure 28 Copying binary data files to the phone

3.4 Decoding the sensor data

3.4.1 Pre-requisites

On the PC, install Anaconda 64 bit Python 3 version. You must run the **setup_conda_env.bat** script to setup the python environment. The batch script can be found in the Decoder folder of the COINES release.

3.4.2 Decoding to CSV

The scripts described are available in the Decoder folder.

- GLP Decoder: This is a python script to convert a binary data file into a CSV. Make use of the **glp_convert_all_bin2csv.bat** to convert all binary data files to CSV in that folder. Refer the readme.md in Decoder/GLP_Decoder folder for further information on decoding the binary data file.
- Dataset Decoder: This is a python script to convert the entire dataset once binary files are placed in right place within the dataset structure. Refer the readme.md in the Decoder/dataset_decoder folder for information on decoding the dataset.
    - Note: When using a Jupyter notebook, the entire decoder folder must be imported prior to the execution of the dataset decoder.

4 Notes

- When logging or file streaming is in progress, do not attempt to view or access the files by connecting to a PC via the USB port. This might lead to data corruption or a crash.
- Only a maximum of 128 files can be fetched via MTP.
- On rare occasions, corruption of data has been observed in the form of bit flips. If this a recurring issue, kindly reach out to our support team on the Bosch Sensortec Community page
- After a firmware update, it is recommended to format the flash memory.
- Uninstall the old APK and delete the BST_Datalogger folder in the phone's storage, before installing a new datalogger APK.
- The application has been tested to be stable with phones supporting MTU sizes of 243 bytes and an Android version above 8.0.
- Refer the datasheet to know more about a sensor's configuration combinations.
- Based on the configured ODR, various parameters of the sensor are set. However, sensor data will be read and stored based on the Sampling Frequency configuration.
- If the sensors are configured in suspend or deep suspend mode, the sensor data logged will be constant values or zeroes.
- Application do not support 6.25Hz, 12.5Hz in sampling frequency.
- Clear the app storage if the application shows previous sensor details in the main page.

5 Legal disclaimer

i. Engineering samples

Engineering Samples are marked with an asterisk (*), (E) or (e). Samples may vary from the valid technical specifications of the product series contained in this data sheet. They are therefore not intended or fit for resale to third parties or for use in end products. Their sole purpose is internal client testing. The testing of an engineering sample may in no way replace the testing of a product series. Bosch Sensortec assumes no liability for the use of engineering samples. The Purchaser shall indemnify Bosch Sensortec from all claims arising from the use of engineering samples.

ii. Product use

Bosch Sensortec products are developed for the consumer goods industry. They may only be used within the parameters of this product data sheet. They are not fit for use in life-sustaining or safety-critical systems. Safety-critical systems are those for which a malfunction is expected to lead to bodily harm, death or severe property damage. In addition, they shall not be used directly or indirectly for military purposes (including but not limited to nuclear, chemical or biological proliferation of weapons or development of missile technology), nuclear power, deep sea or space applications (including but not limited to satellite technology).

Bosch Sensortec products are released on the basis of the legal and normative requirements relevant to the Bosch Sensortec product for use in the following geographical target market: BE, BG, DK, DE, EE, FI, FR, GR, IE, IT, HR, LV, LT, LU, MT, NL, AT, PL, PT, RO, SE, SK, SI, ES, CZ, HU, CY, US, CN, JP, KR, TW. If you need further information or have further requirements, please contact your local sales contact.

The resale and/or use of Bosch Sensortec products are at the purchaser's own risk and his own responsibility. The examination of fitness for the intended use is the sole responsibility of the purchaser.

The purchaser shall indemnify Bosch Sensortec from all third party claims arising from any product use not covered by the parameters of this product data sheet or not approved by Bosch Sensortec and reimburse Bosch Sensortec for all costs in connection with such claims.

The purchaser accepts the responsibility to monitor the market for the purchased products, particularly with regard to product safety, and to inform Bosch Sensortec without delay of all safety-critical incidents.

iii. Application examples and hints

With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Bosch Sensortec hereby disclaims any and all warranties and liabilities of any kind, including without limitation warranties of non-infringement of intellectual property rights or copyrights of any third party. The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. They are provided for illustrative purposes only and no evaluation regarding infringement of intellectual property rights or copyrights or regarding functionality, performance or error has been made.

6 Document history and modification

Rev. No	Chapter	Description of modification/changes	Date
1.0	All	Initial release	June 2021
1.1	All	Added new sensors support	April 2021

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