Hitachi HOT-1000: MATLAB GUI

Developed and compiled using MATLAB R2017b.

Precautions

1. Even for testing purposes, please wear the HOT-1000 on your forehead or mannequin head instead of leaving it on the table, in contact with nothing. If you don't, although the device's status shows that it is measuring, it doesn't output any data so in the end your time series data will be empty.

2. We have tested many times. Each dongle is able to connect to a maximum of three devices at a time. The fourth and subsequent devices' status will appear as not NIRS. Once the status appears to be not NIRS, nothing can be done to change the status other than restarting the PC and running the GUI again.

3. For simultaneous measurement up to three devices, we recommend to set up the devices one by one, i.e. ensure the first device is connected then only switch on and connect the second device and so on. Trying to connect to three devices at once sometimes works, sometimes doesn't.

4. The Bluetooth range decreases with increasing number of connecting devices. We have tested. The range seems to be within 2–3 meter when the dongle is connected to three devices. Besides that, we also note that the Bluetooth seems to be more stable and the range is bigger when connection is successfully established.

5. Two AAA alkaline batteries last up to only approximately 1.5 hours and there is no way to know the current battery level. When the battery charge is low, you will see:
   - the emitter will turn on and off irregularly.
   - the device will connect and disconnect with the PC, as reflected in the status.
   - the status will give an error, as reflected in the status.

   It is recommended to use a power bank or charge via USB port instead.

6. In the HOT1000 controller (http://127.0.0.1:9876/), status of the device(s) will be shown. There are only a few possible status:
    - READY – Device is ready to measure.

    - measuring – Measurement is ongoing.

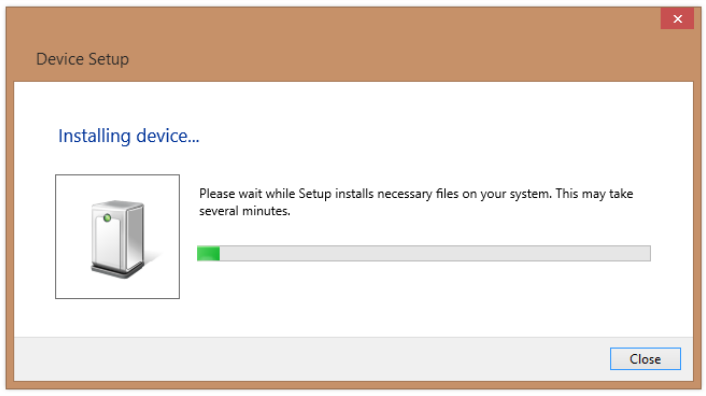
    - DISCONNECTED – Device is connected and turned off. If it is not deliberate, then it is highly probably the battery charge is low.

    - not NIRS – Device is not detected as HOT1000. If the device indeed is HOT1000, once the status appears to be not NIRS, nothing can be done to change the status other than reset or rescan using the GUI again. Do take note that one dongle can connect up to a maximum of three devices only.

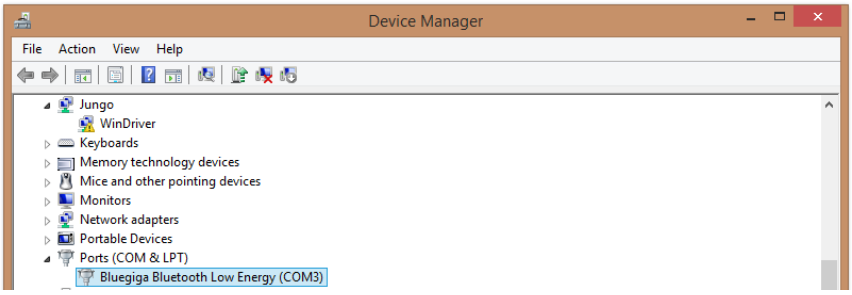
One-Time Setup

Hardware

- ***Bluegiga BLED 112 USB dongle (link)***
  1. Plug the dongle into your USB port and you should see the device installing itself.



  2. If installed successfully, you should be able to see Bluegiga Bluetooth Low Energy (COM X) under Ports (COM & LPT) in the Device Manager. X varies depending on your PC and also which USB port you are using.



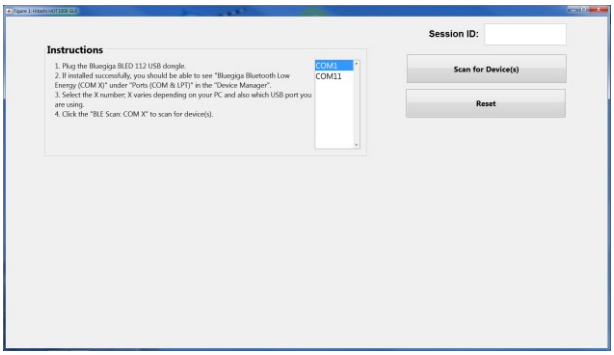
  3. If not, means the device installation failed, download the driver (link) and install manually.

Software

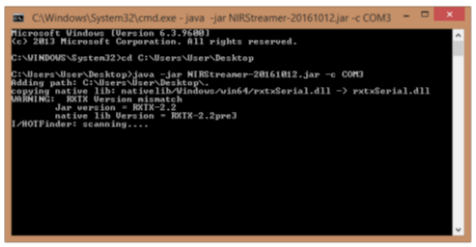
- ***Java***
  1. Download and install Oracle Java 8 (link).

Procedures to Use the GUI

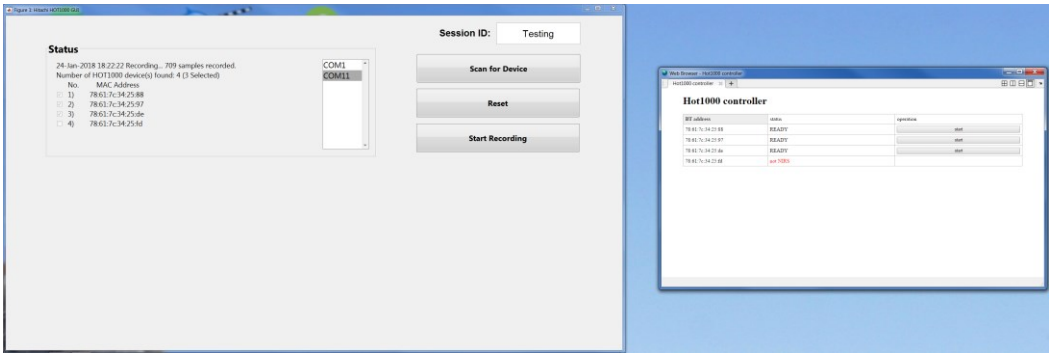
1. Plug the Bluegiga BLED 112 USB dongle into your USB port (be consistent i.e. plug into the same port every time).
2. Open the Device Manager to see if Bluegiga Bluetooth Low Energy (COM X) is listed under Ports (COM & LPT). X varies depending on your PC and also which USB port you are using. Hence, the importance of plugging into the same port every time.
3. Download and extract the entire MATLAB GUI folder.
4. Open MATLAB and change directory the extracted folder.
5. In the command window, type and enter HOT1000_GUI. A GUI will automatically pop up. Key in your session ID, by which your data will be saved as per the input. Select your dongle COM number. Then click Scan for Device(s).



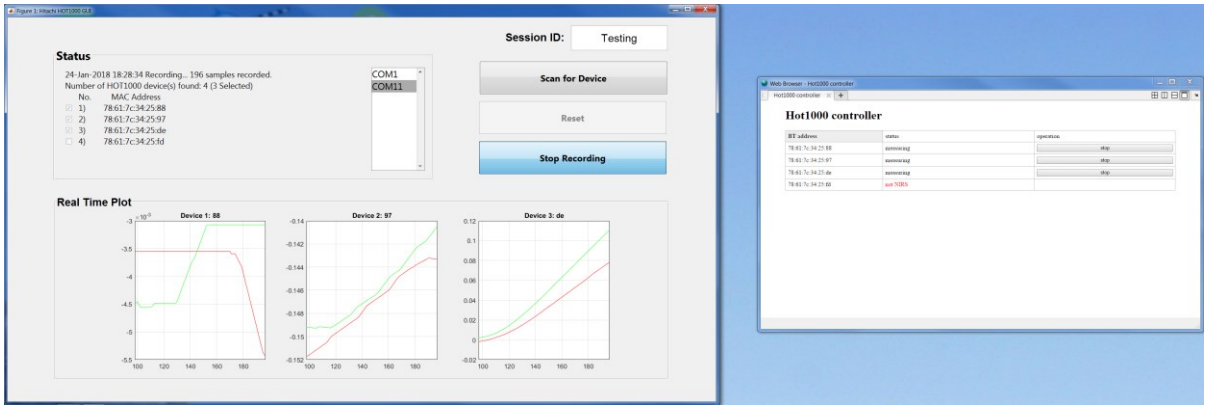
6. The GUI will automatically launch the command prompt and execute the java file provided by Hitachi in background. Please don't close the command prompt.

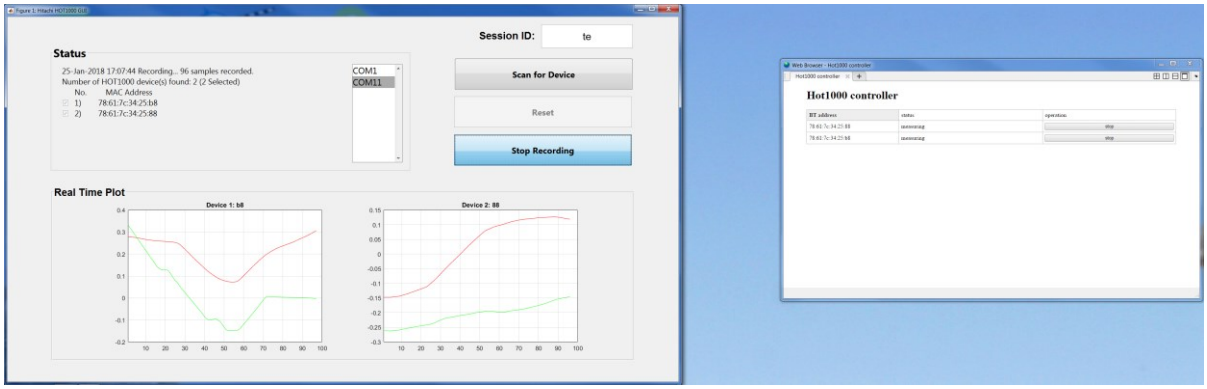


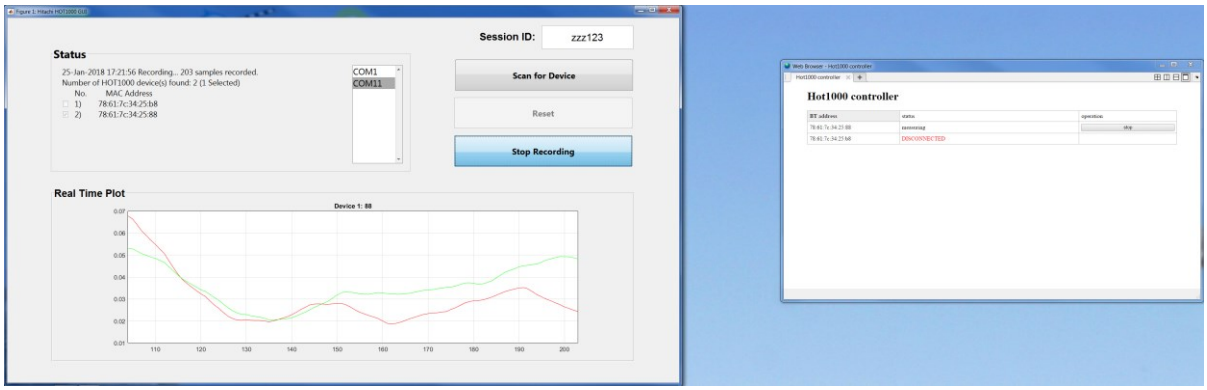
7. Once done, list of detected HOT1000 devices will be shown and a browser accessing localhost will pop up automatically. Click Scan for Device to run the scanning again or Reset to reset the GUI. Do take note that one of the GUI's limitations is its inability to read the devices' status and each dongle is able to connect to a maximum of three devices at a time. Beyond that number, the devices will be detected as not NIRS. Once the devices appear to be not NIRS, the only solution is to reset or rescan using the GUI.



8. Select (tick) the desired devices which are already in READY state. To synchronize simultaneous measurement of multiple devices, click the start button on the localhost for respective devices before clicking Start Recording on the GUI. If there is only a device, it doesn't matter which start button is clicked first. Number of samples collected together with real time plots will be shown.







9. Click Stop Recording on the GUI to stop recording. Stopping the device first will result in the GUI stuck in infinite loop. Once stopped, the data sampled will be automatically saved as per the session ID. For example, if three devices are used and the session ID is testing, data from all three devices will be saved as testing.mat. The data follows a specific format, format i.e. data point x 14 (sampling rate = 10 Hz; 10 data points per second).

Column Number	Data Stored
1	Headset time (sec)
2	HbT change (left subtracted)
3	HbT change (right subtracted)
4	Estimated pulse rate
5	HbT change (left SD 1 cm)
6	HbT change (left SD 3 cm)
7	HbT change (right SD 1 cm)
8	HbT change (right SD 3 cm)
9	Saturation (left SD 1 cm)
10	Saturation (left SD 3 cm)
11	Saturation (right SD 1 cm)
12	Saturation (right SD 3 cm)
13	Noise detection flag
14	Mark

10. Alternatively, the data is automatically saved as excel file in HOT_Log folder.
11. The GUI is straight away ready for another round of data recording i.e. it is not necessary to reset the GUI.