



**INDIAN INSTITUTE OF TECHNOLOGY BOMBAY
MATERIALS MANAGEMENT DIVISION
Powai, Mumbai - 400076**

PR No.1000015996

RFx No. 6100000697

Technical Specifications for Wearable fNIRS combined with an EEG system

1. Hardware for research-grade wireless and wearable fNIRS combined with an EEG system:

A. Research-grade wireless and wearable fNIRS system: Following features/configurations/requirements should be delivered (along with all the hardware, software and accessories). Notably, at least five studies should have been published in reputed international journals by using the quoted fNIRS combined with an EEG system.

- Must have a minimum of 8 fNIRS channels.
- Must be able to use all fNIRS channels to collect data from any part of the whole head (full cortical surface) including frontal lobe.
- Must have high power and low power with dual-wavelength NIRS source.
- The minimum sampling rate should be at least 6Hz.
- Must be able to acquire hemodynamic changes (oxy-, deoxy-, total haemoglobin levels) at the surface of the brain and at least up to 1-2 cm below the cortical surface.
- fNIRS combined with an EEG system must possess multi-modal compatibility to be used along with the ExG/GSR/SpO₂/other biosignal devices and allow simultaneous recording of multi-modal data.
- Must work in sync with GTEC's "g.HIamp 64Ch Research" EEG system (MATLAB SIMULINK/python API based).
- The fNIRS system must stream data in real-time to another data processing hardware/software through TCP/IP/UDP or using other network protocols.
- Technical assistance for integration of the fNIRS channels with the EEG system must be provided after the sale of the fNIRS combined with an EEG system.
- The fNIRS system must be powered by lithium-Ion battery packs, which can allow continuous fNIRS recording for at least 3 hours.
- All fNIRS system modules meant for fNIRS, and auxiliary channels must be modular and wearable.
- fNIRS caps must support concurrent use with electroencephalography electrode (EEG) devices proposed for clauses.

B. Research grade wireless and wearable EEG system: Following features/configurations/requirements should be delivered (along with all the hardware, software and accessories):

- EEG amplifier must be a minimum 32-channel amplifier system with active electrodes and continuous-simultaneous recording capability on all channel
- All EEG amplifier modules meant for EEG, and auxiliary channels must be modular and wearable.
- Should have up to 32 mono-polar / 16 bi-polar input channels with GND and REF (software selectable).
- The amplifier must have simultaneous attachment provisions (via

analogue input, digital input, attachment on EEG Channel, etc.) for all of the listed Wearable and wireless sensors (in this point)

- galvanic skin response GSR
- electrocardiogram ECG
- Temperature and respiratory sensor or EMG

- EEG amplifier must enable acquisition with lesser number of EEG channels (e.g., 1 to 32 channels)
- Each of the amplifier channels must have a sampling rate of at least 240Hz at 16bit resolution.
- The amplifier should have 3-axis accelerometer.
- Amplifiers must be powered by lithium-Ion battery packs which can allow continuous EEG recording for at least 3 hours.
- It should be a real DC-coupled amplifier.
- It must be possible to house the acquisition computer and the setup (wearable: EEG cap, amplifiers, etc.) in different rooms. Appropriate extension cables and connectors must be provided to run cables during installation.
- Should have 8 digital trigger inputs at the amplifier base station.
- Must work in sync with GTEC's "g.HIamp 64Ch Research" EEG system (MATLAB SIMULINK/python API based).
- Supplied 32 Active gel-based electrodes must possess active pre-amplifiers and preferable with impedance measurements on the electrodes themselves or on the amplifier.
- fNIRS combined with an EEG system electrode cap must support continuous recording with stable impedance over a time period of at least 3 hours.
- EEG caps should support easy cleaning and maintenance.
- EEG caps must support concurrent use with near-infrared spectroscopy sources/detectors (fNIRS) devices proposed for clauses.
- It should have a USB interface for data transfer to the PC/Laptop.

2. Software for research-grade wireless and wearable fNIRS combined with an EEG system:

- The software should provide integrated and independent functionality where fNIRS and EEG system can be used independently or simultaneously together in synchronized data acquisition.
- fNIRS combined with an EEG system software must acquire fNIRS and EEG data simultaneously and synchronized, along with other biosignal data (ExG, GSR, SpO₂, pulse, respiration, airflow, etc.) synchronized.
- This software must be compatible (synchronization) with GTEC's "g.HIamp 64Ch Research" version. It is a responsibility of a vendor to set up this system and licenses to the required specification.
- fNIRS combined with an EEG acquisition system must provide for real-time visualization of all channels connected to the system, including external triggers from stimulation devices (audio, visual, peripheral nerve, bio-signal sensors, etc.).
- fNIRS combined with an EEG acquisition system must contain a provision to change acquisition settings on each channel and also adjust montages of the recording setup.
- fNIRS combined with an EEG acquisition system must allow easy change of reference electrode of EEG for data acquisition.
- The acquisition and review software should provide a synchronized and integrated solution to capture fNIRS, EEG, ECG, EMG, GSR, SpO₂, pulse, respiration, airflow, etc.

- The recorded data format must be easily readable and analyzable with major EEG processing toolboxes (such as Fieldtrip, MNE-Python, BrainStorm, SPM, etc.) and with major fNIRS processing toolboxes (such as HOMER2, etc.).
- The amplifier should be supplied with a real-time processing software interface (SIMULINK/Python API based) with real-time access to bio-signal data acquired by the amplifier.

3. Consumables for research-grade wireless and wearable fNIRS combined with an EEG system:

- fNIRS combined with an EEG system caps: Kids (6 years or 6+ years old) and adult (8-32 inch) caps should be supplied in Small (2 quantity), Medium (2 quantity), and Large size (1 quantity).
- Extra battery pack for fNIRS combined with an EEG system should be supplied.
- Wearable and wireless sensors (hardware, software, and accessories for all listed sensors should be supplied) for the synchronized recording of data
 - galvanic skin response GSR
 - electrocardiogram ECG
 - Temperature and respiratory sensor and EMG
- Spare electrodes for EEG (at least 4 quantity)
- Cable to connect amplifier to the computer (trigger cable)
- At least 500 grams of abrasive gel should be supplied (for skin preparation while using the active/passive electrodes for recording).
- At least 1 litre of water-soluble, non-abrasive, high viscosity gel should be supplied (for skin preparation while using the active/passive electrodes for recording).
- Two quantities of syringe should be supplied (will be used to fill the gel into the active/passive electrode).