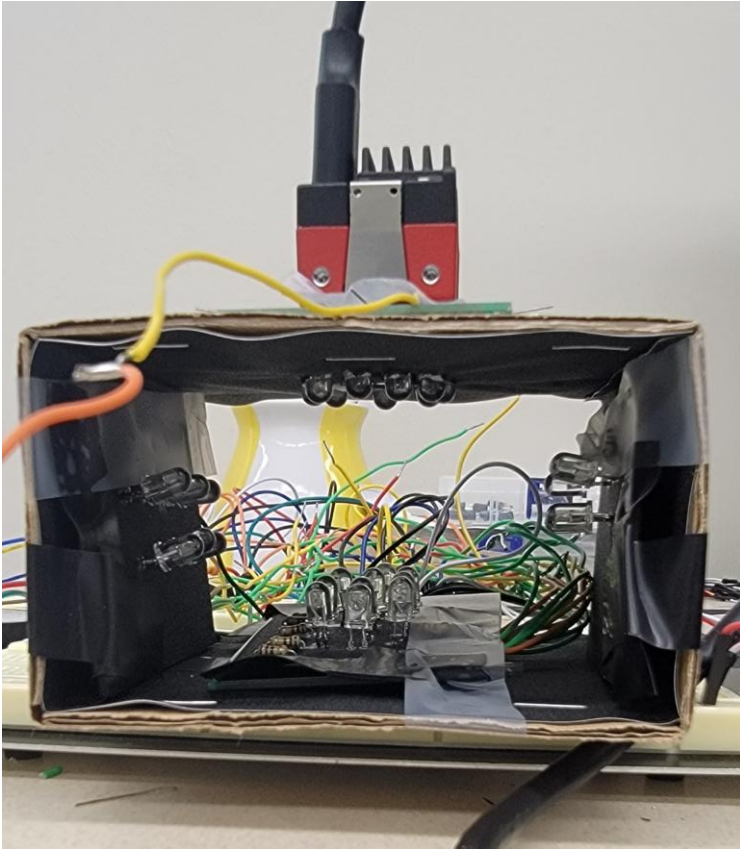


Project Title: DVIS: A Wearable Deep Vascular ID System

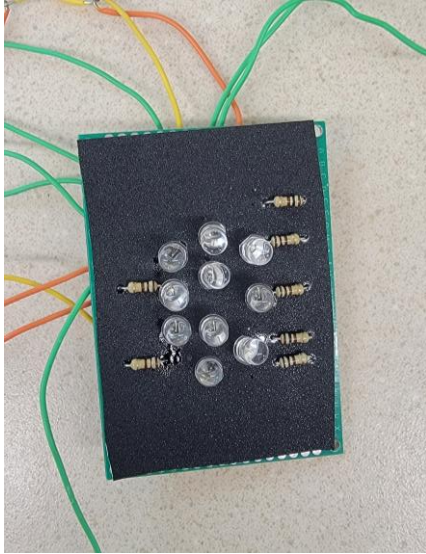
Nano Computing Research Group

IR Imaging Setup Progress



- IR image setup using High power LEDs (870nm)
- New setup to capture IR images for both reflected and refracted rays, LEDs touching the skin with high intensity of IR light from IR LEDs focusing on all the four sides of the hand

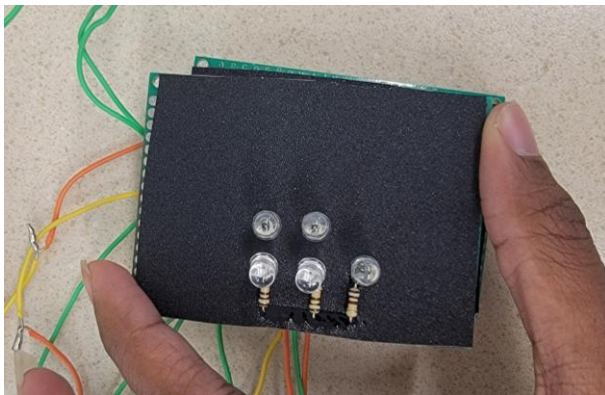
Zones in hardware setup



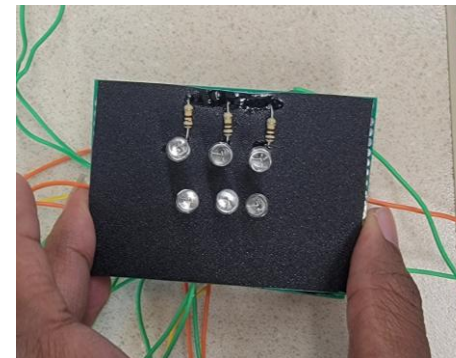
Zone 1 bottom side of the hand



- Zone 3 top side of the hand
- upper view of the setup with a hole for camera on the bottom side to capture IR images



Zone 2 left side of the hand



Zone 4 right side of the hand

Setup to prevent ambient light



Inner view of the box



Curtain to the box(to insert hand)

- Black film wrapped inside a box and an opening on one side
- IR image setup is placed inside box to avoid ambient light from external

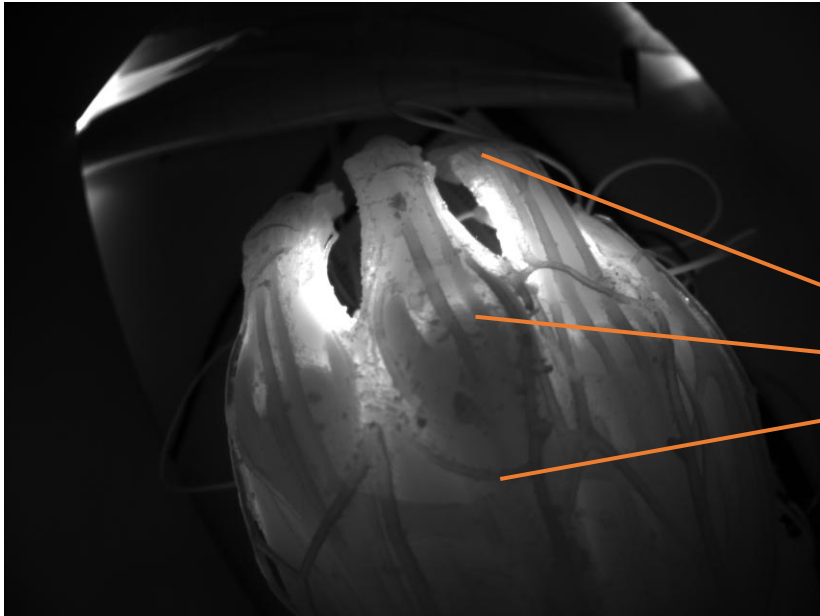
Phantom:



The 3D printing of the wrist was done using an off-the-shelf model of hand from [sketchfab.com](https://www.sketchfab.com).

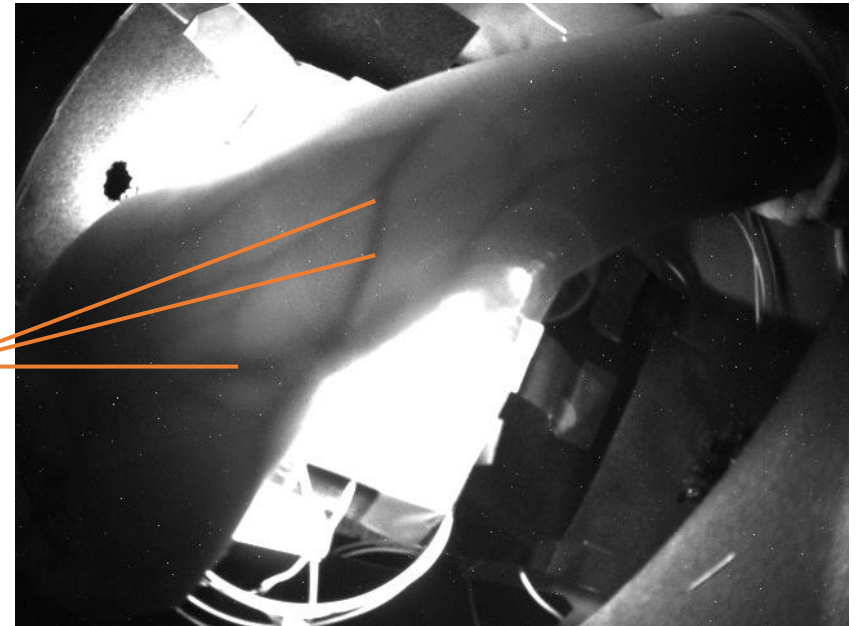
NIR Captured Images – Phantom

Exposure: 47498.609 μ s
Gain: 12.8dB



Phantom Wrist model

Exposure: 759912.957 μ s
Gain: 7.2dB

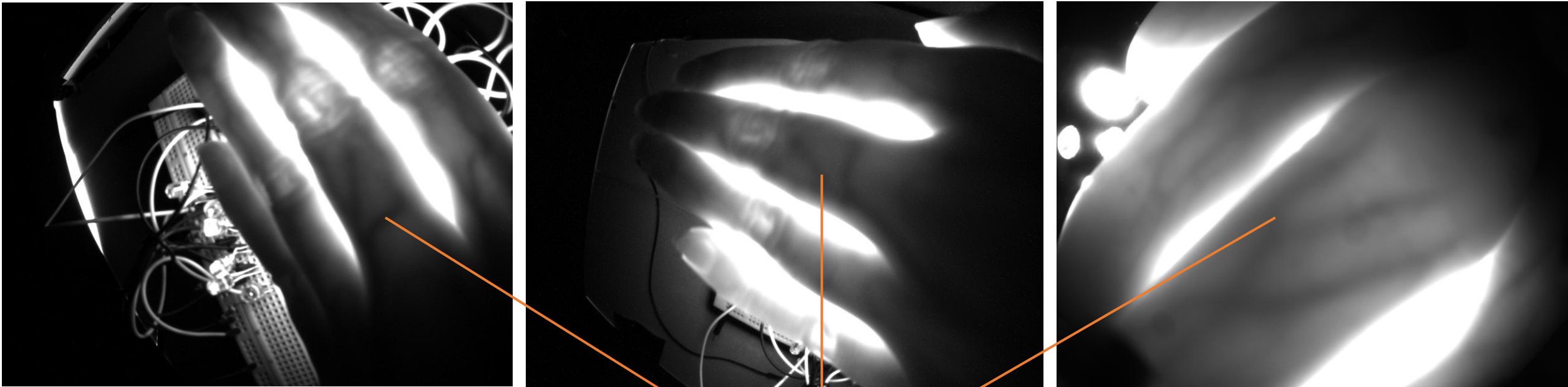


Human Wrist at 90 degrees

Veins

IR images of wrist and Phantom model taken
in dark environment.

NIR Captured Images - Fingers



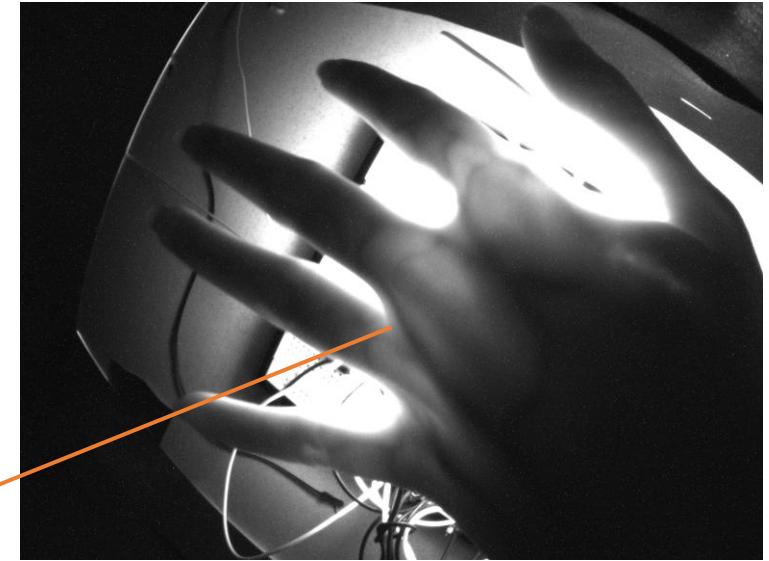
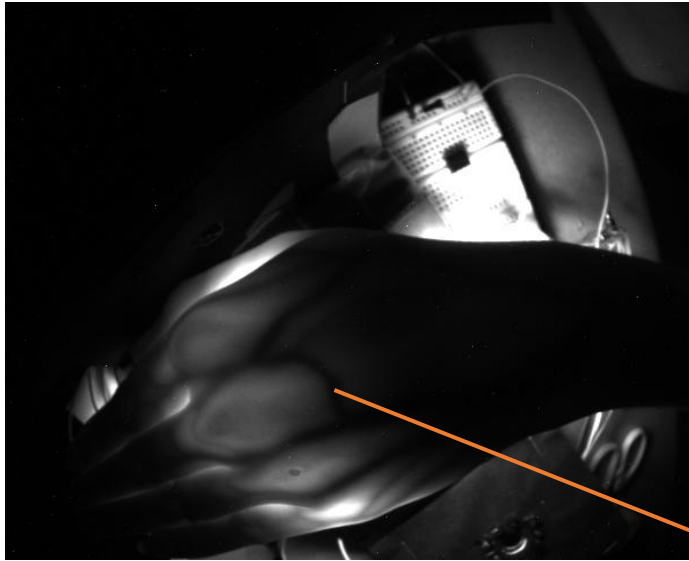
Veins

Exposure: 849040.870 μ s Gain: 7.2dB

IR images of wrist taken in a dark environment
captured at various angles of the fingers

NIR Captured Images - Palm

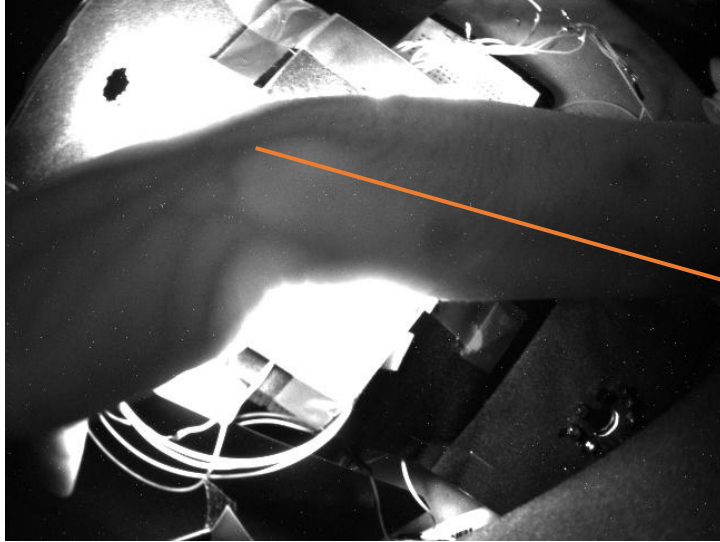
Exposure: 849040.870 μ s Gain: 16.8dB



Veins

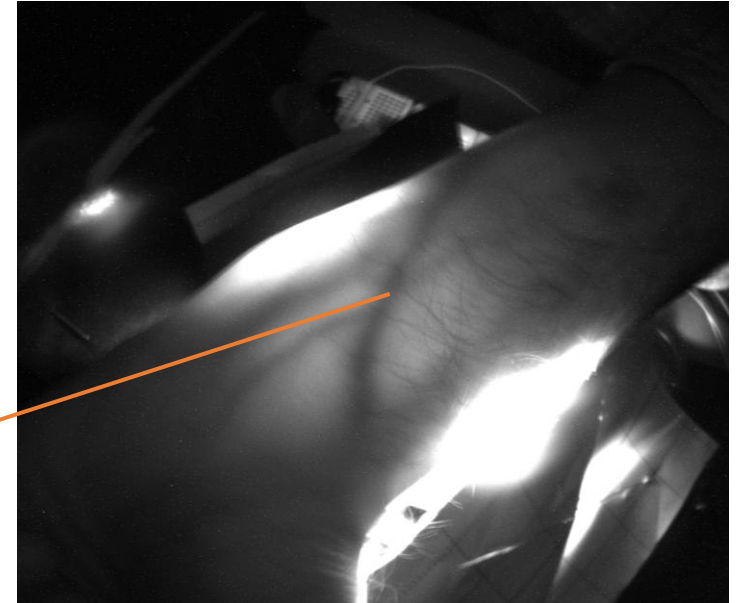
IR images of the wrist captured with various angles
at different exposure levels & Gain values

NIR Captured Images - Wrist

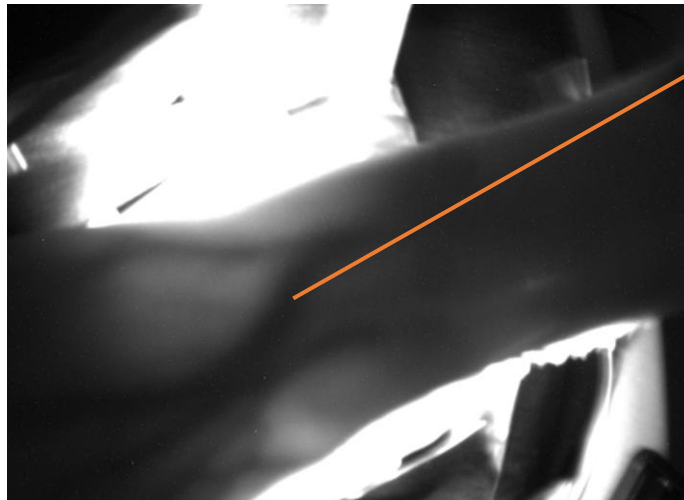


Wrist at 70 degrees

Exposure: 280081.130 μ s
Gain: 2.4dB



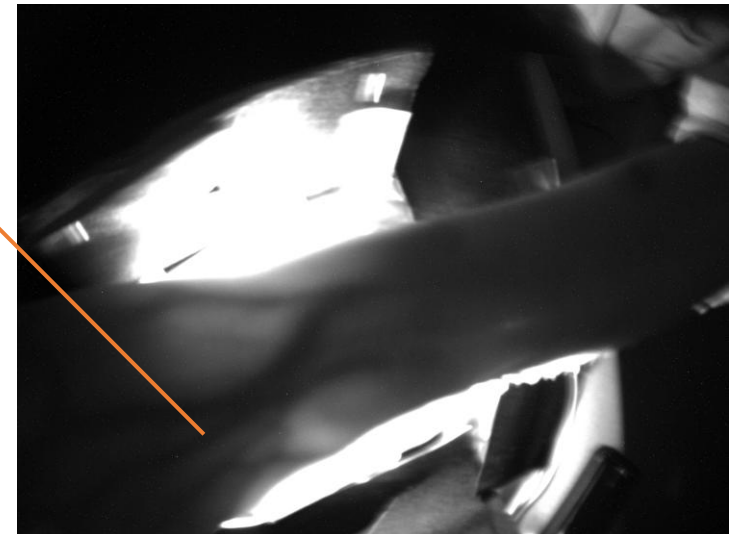
Wrist at 89 degrees



Wrist at 90 degrees

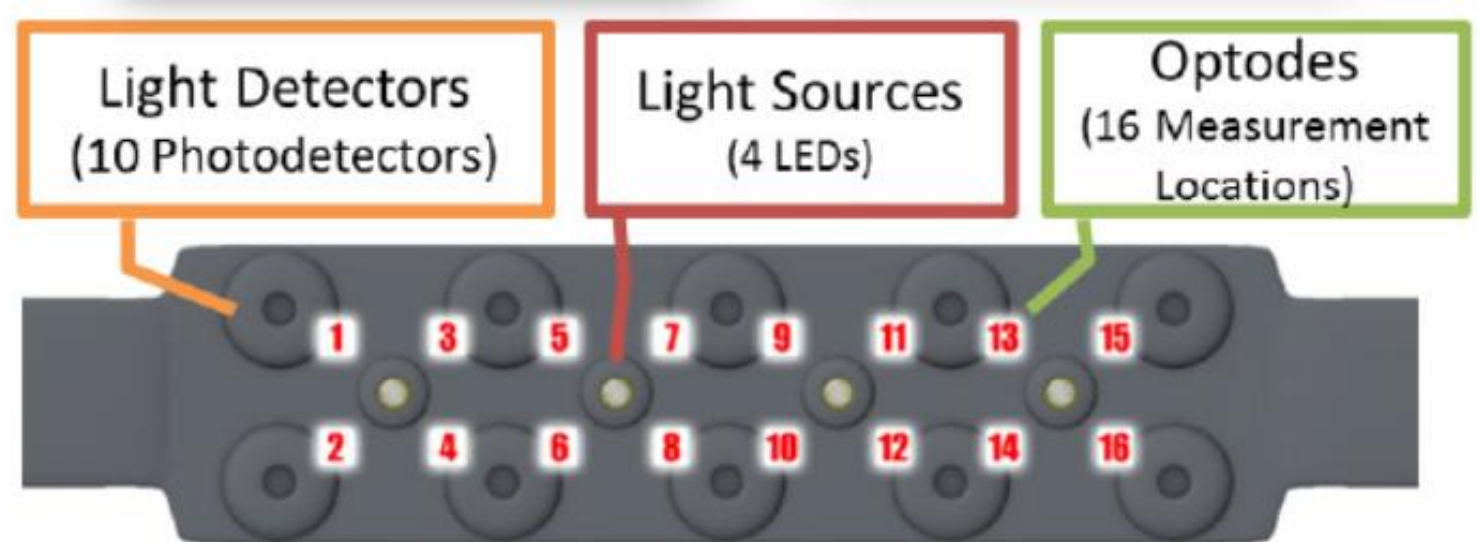
Veins

IR refracted images of
back side of the wrist
with high intensity IR
light on bottom side
of hand



Wrist at 80 degrees

fNIR System



The LEDs are activated one at a time in sequence. Each time an LED is activated, the four detectors surrounding it are sampled. The sensors measure the light that is reflected back from the red blood cells through the scalp and skull. The arrangement of the four LEDs and 10 sensors, results in the data being collected in 16 channels. For each of the 16 measurements, fNIR shows the level of HbO in red and of HbR in blue.

fNIR Setup:



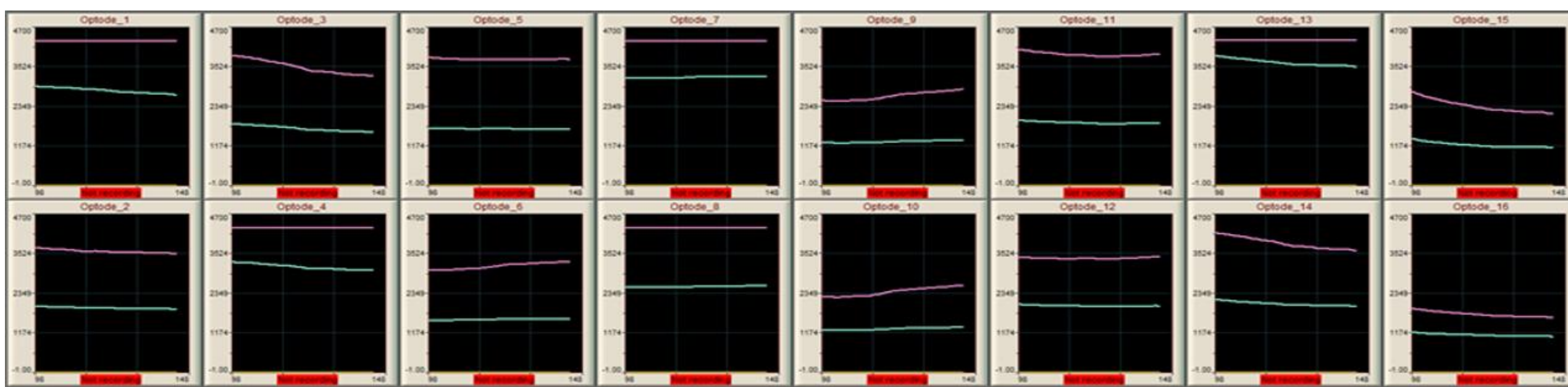
Sensors and LEDs covering the
Top side of the wrist



Sensors and LEDs covering the
bottom side of the wrist

fNIR Image (Top side of wrist)

Red line – NIR data at 850 nm
Green line – NIR data at 730 nm



COBI Studio software collects raw fNIR signals for 16 channels and 2 wavelengths and transmit them through Ethernet or wireless network (via TCP/IP) to the Protocol Computer.