Patch type Application

2022. 02. 14

NMBL

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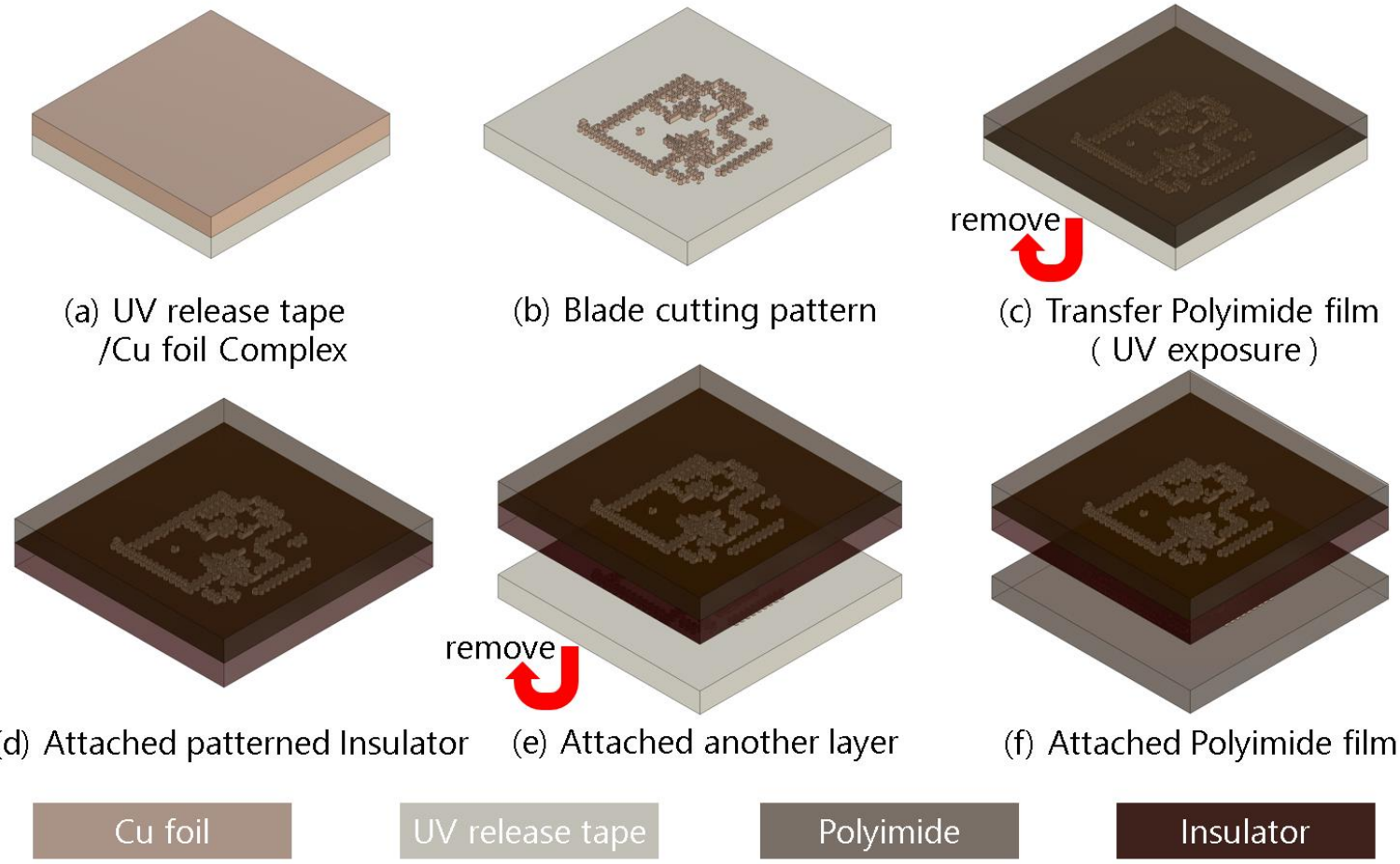
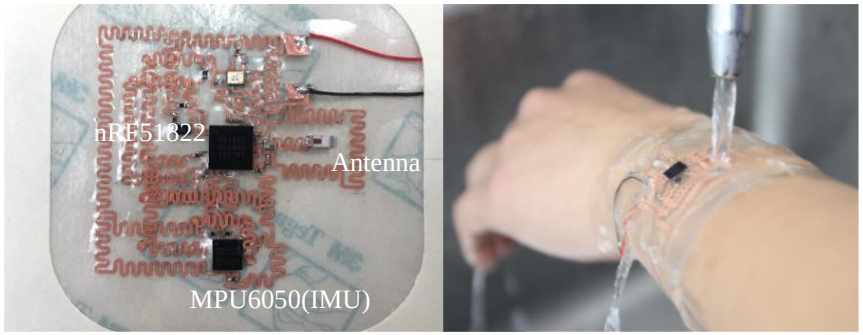
Epidermal Sensor

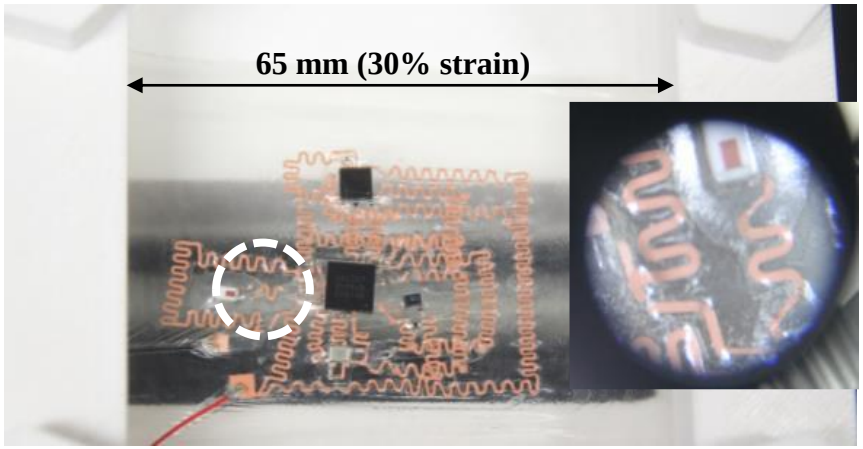
✓ Fabrication – "Cut-and-Paste" method

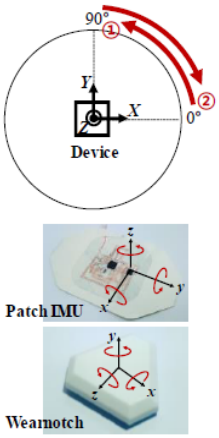


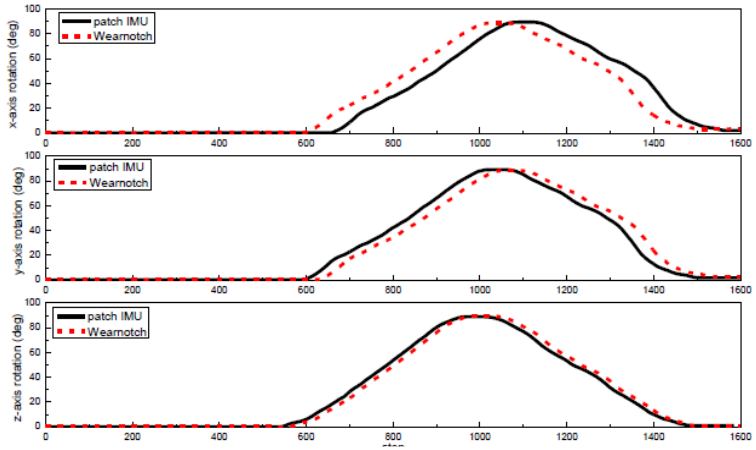
Previous Study

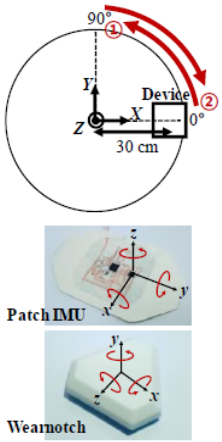
✓ Signal - IMU Sensor

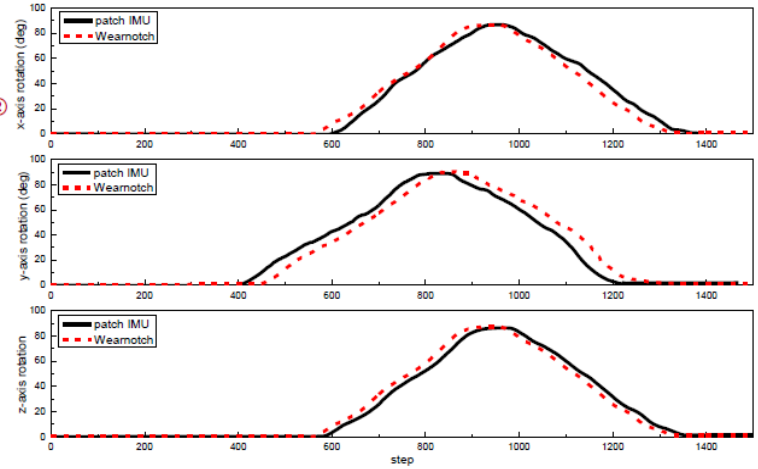






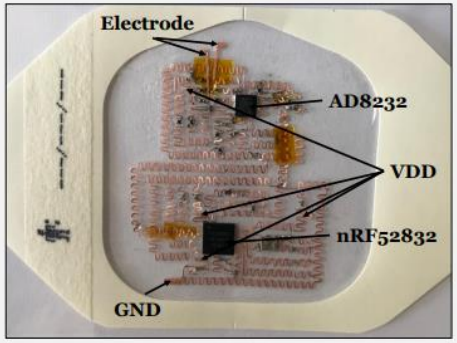




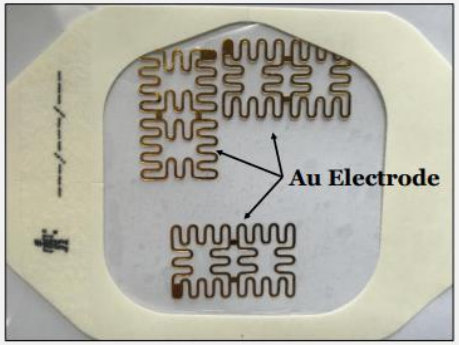


Previous Study

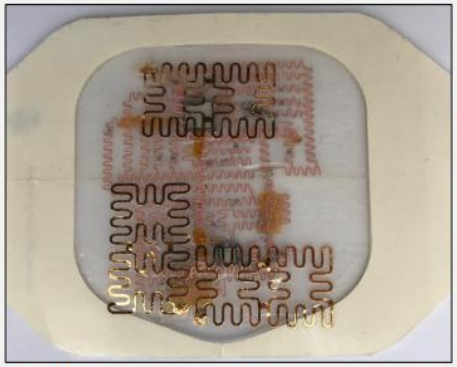
✓ Signal - ECG Sensor



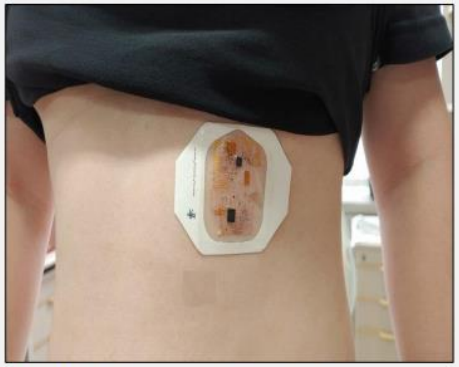
(a) Main patch layer



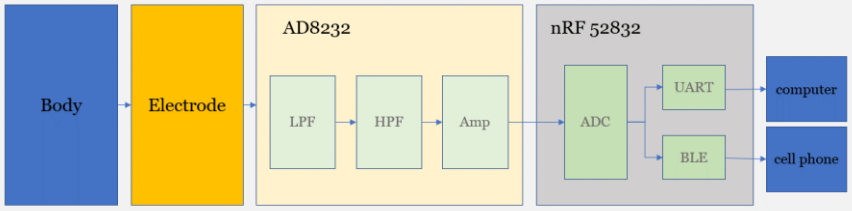
(b) Electrode layer

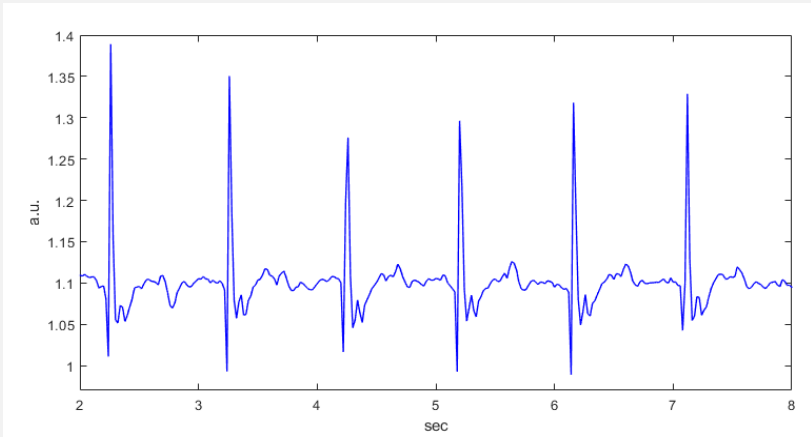


(c) Double layers of the main patch and the electrode



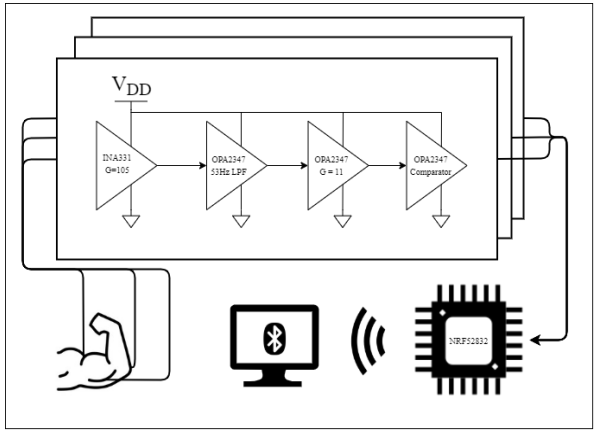
(d) Attachment on the chest

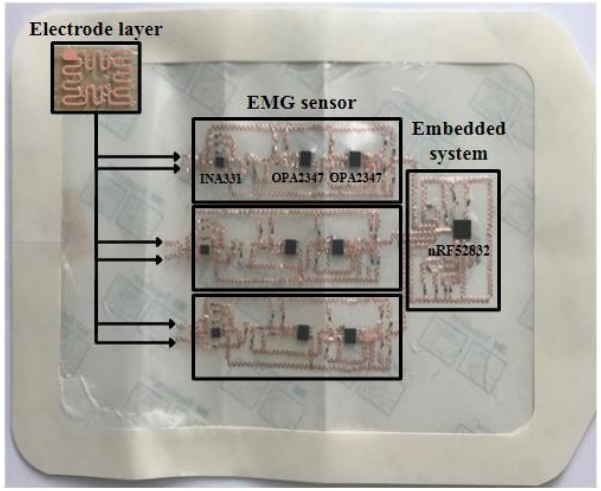


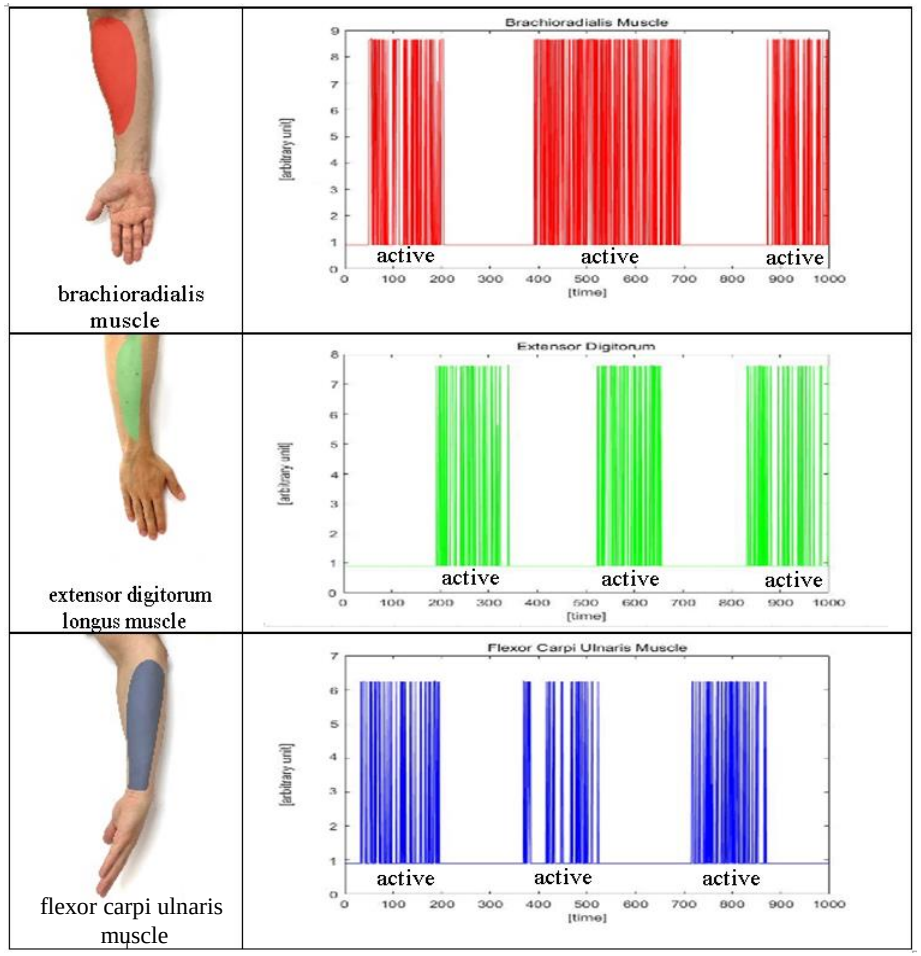


Previous Study

✓ Signal - EMG sensor

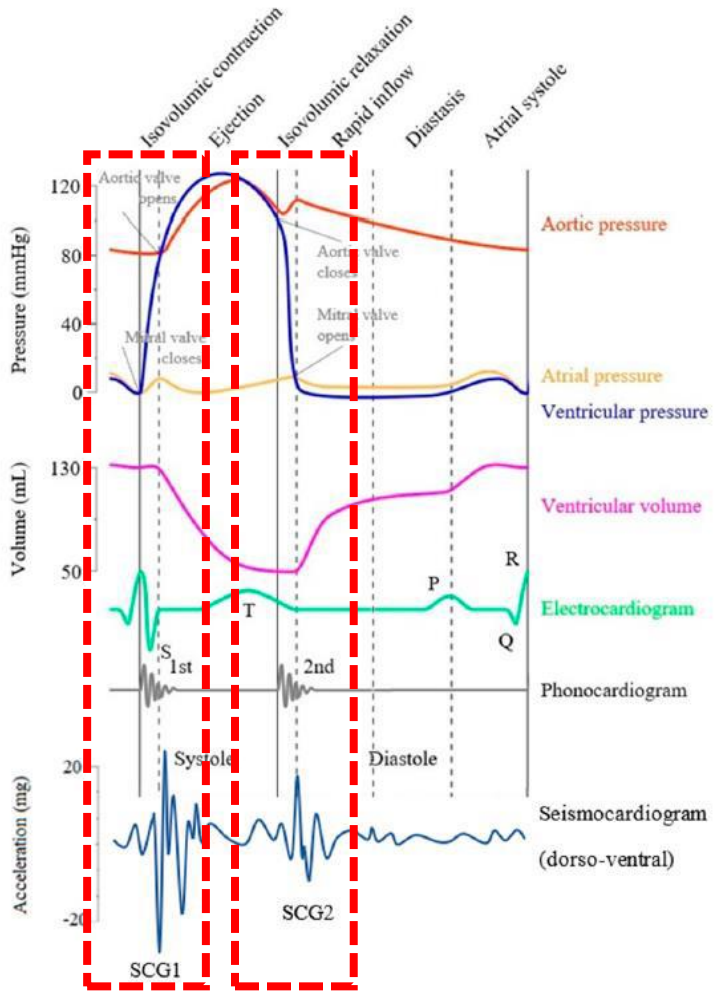


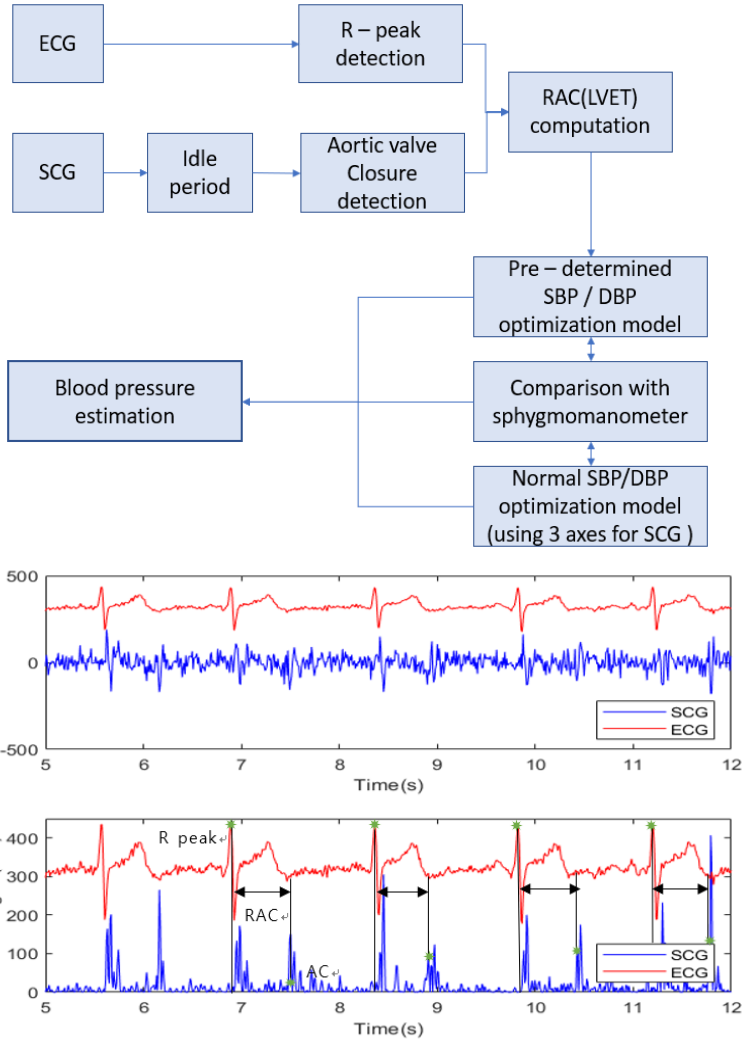




Previous Study

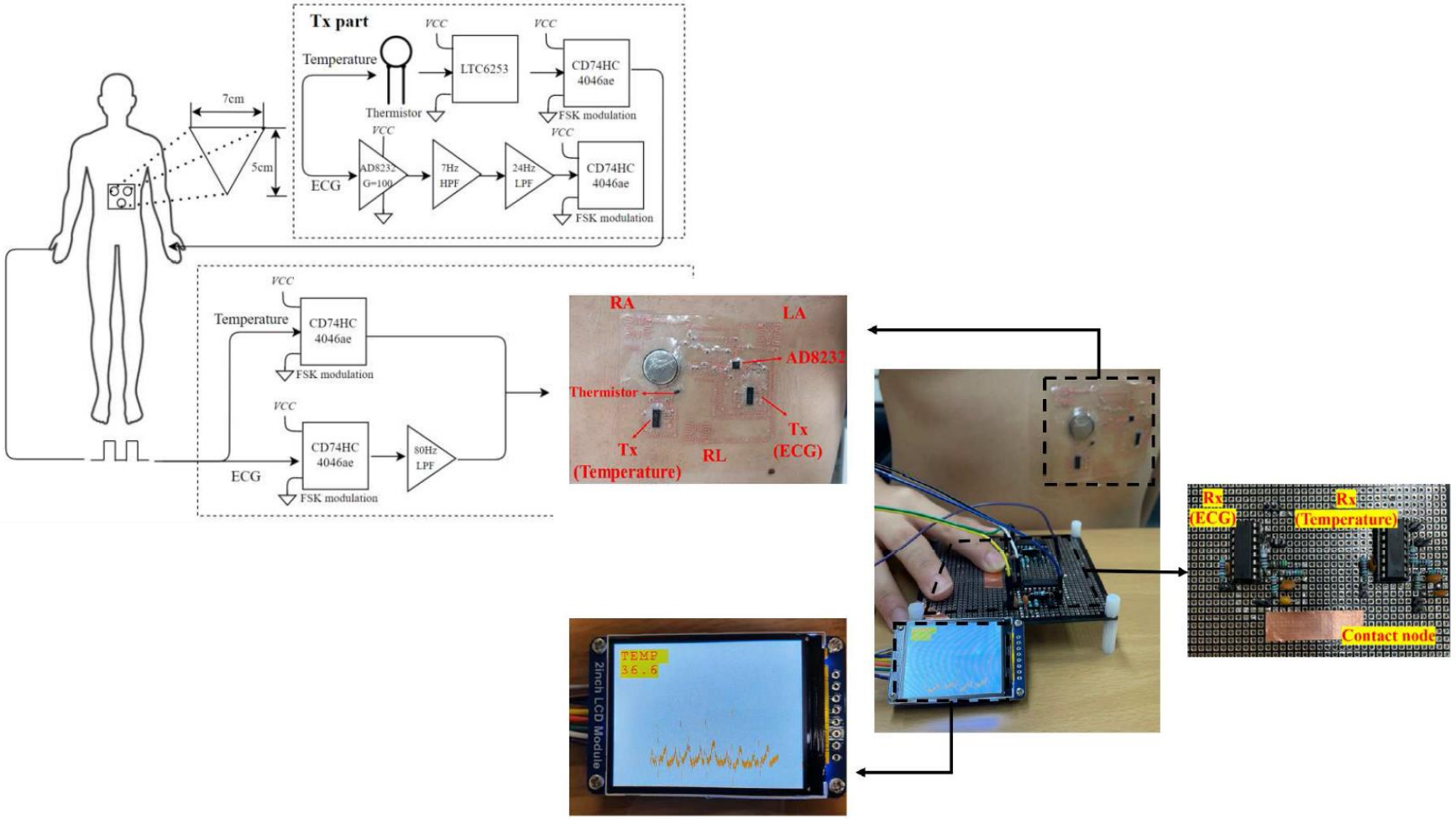
✓ Cuffless Blood Pressure Estimation (IMU + ECG)





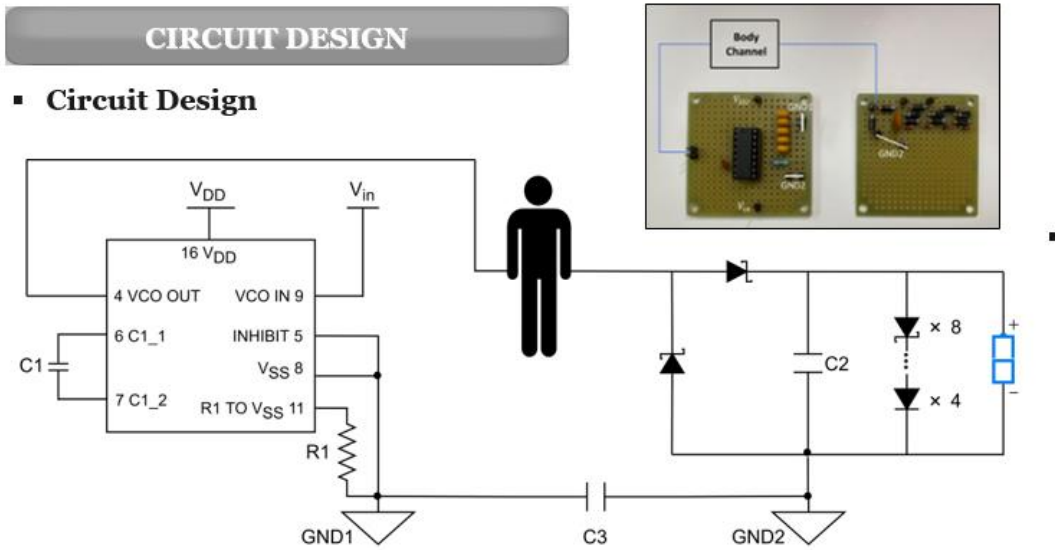
Previous Study

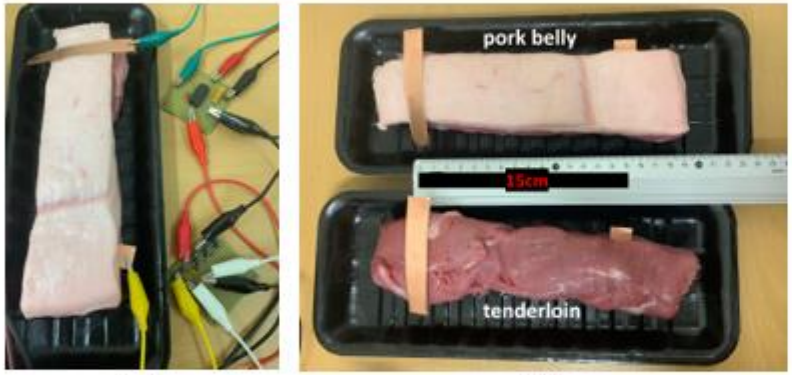
✓ Communication method - Body channel communication (BCC)



Previous Study

✓ Communication method – BCC (Body-coupled power transmission)





(a) (b)

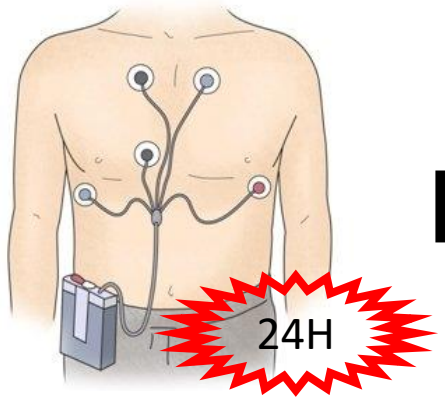
Figure 5. (a) Copper Electrodes Attached to surface (TX) and Implanted in tissue (RX), (b) Indicating determined distance between two electrodes

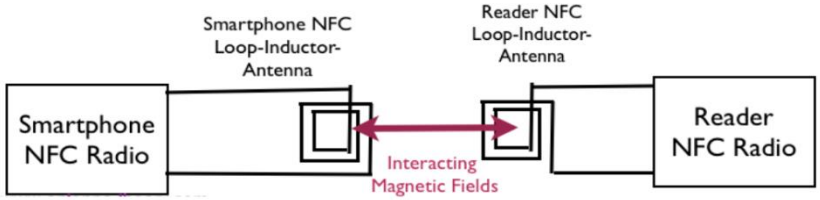
Table 2. Comparison according to rate of Muscle and Fat

	Pork Belly	Tenderloin
Voltage (V)	4.18	4.45
Total Current (mA)	2.58	4.87
Total Power (mW)	10.8	21.672
Load Current (mA)	2.07	4.28
Load Power (mW)	8.65	19.046

Previous Study

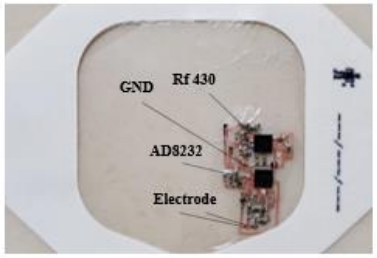
✓ Communication method – Near Field Communication (NFC)



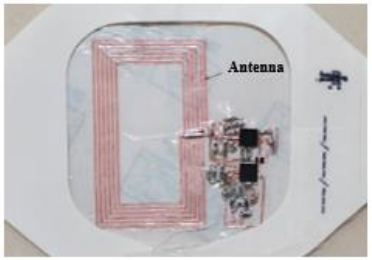


Holter Test

Using NFC powered ECG sensor

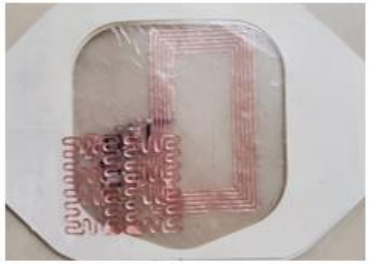


(a) Main patch layer

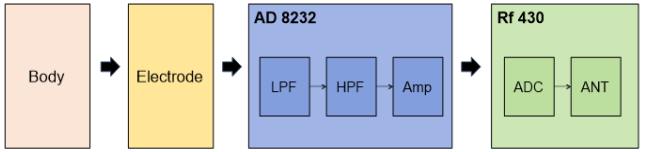


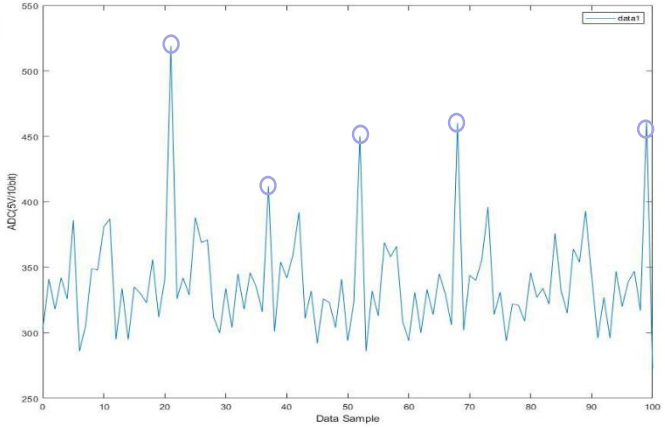
(b) Main patch and Antenna

(c) Electrode layer



(d) Double layers of the main patch and the electrode





Previous Study

✓ Communication method – Bluetooth Low Energy (BLE)

nRF Connect SDK guide

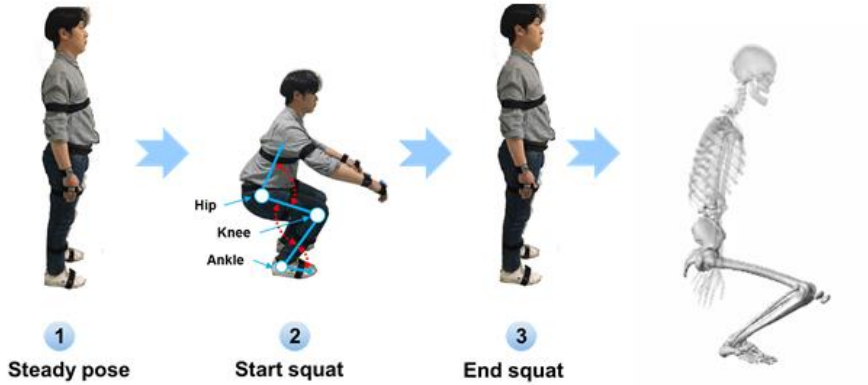
nRF9160 software guide

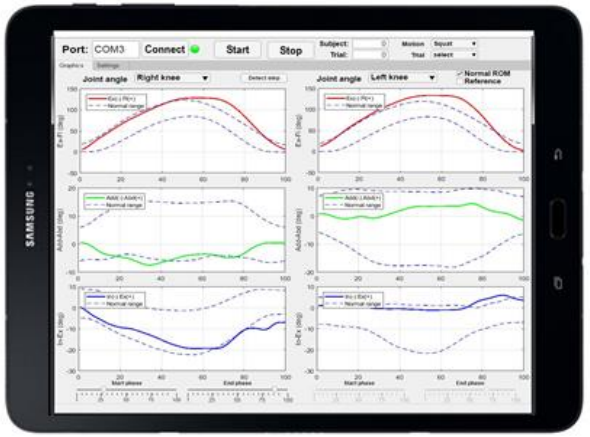
Comparison of our Bluetooth LE SoCs

SoC	nRF5340	nRF52840	nRF52833	nRF52832	nRF52820	nRF52811	nRF52810	nRF52805
Bluetooth	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
Thread	Yes	Yes	Yes		Yes	Yes		
Matter	Yes	Yes						
Zigbee	Yes	Yes	Yes		Yes			
Bluetooth Mesh	Yes	Yes	Yes	Yes	Yes			
Flash	1 MB + 256 KB	1 MB	512 KB	512/256 KB	256 KB	192 KB	192 KB	192 KB
RAM	512 KB + 64 KB	256 KB	128 KB	64/32 KB	32 KB	24 KB	24 KB	24 KB
CPU	128 MHz Arm Cortex-M33 + 64 MHz Arm Cortex-M33	64 MHz Arm Cortex-M4 with FPU	64 MHz Arm Cortex-M4 with FPU	64 MHz Arm Cortex-M4 with FPU	64 MHz Arm Cortex-M4	64 MHz Arm Cortex-M4	64 MHz Arm Cortex-M4	64 MHz Arm Cortex-M4

Current Study

✓ EMG sensor - IMU + EMG sensor (3D human activity Estimation)





초기에는 무릎 고정을 위한 Brace를 사용하여 무릎 굽힘 폄 운동 실시

= IMU를 이용하여 무릎 각도 측정 ▶ 각도 기반 컨텐츠 제작

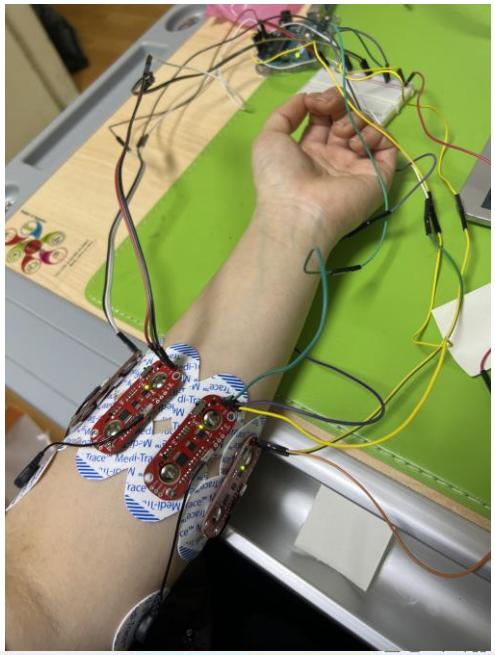
❖ 초기에는 운동 각도를 좁게, 갈수록 넓게

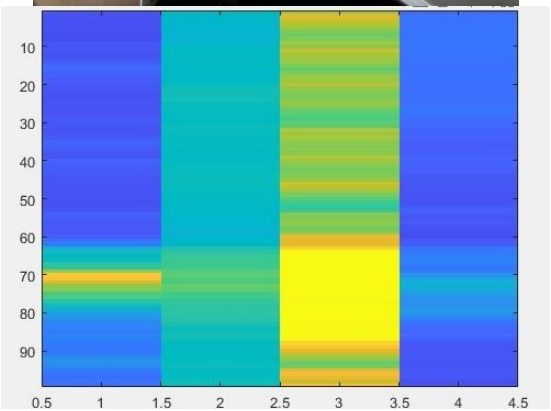
1. 무게 – 1,040g
2. IMU 및 EMG 측정
   (10도 ~ 120도 조절 기능)
3. 사이즈 조절을 통한 환자 범용성
   (50 ~ 65CM 7단계 조절 기능)

사용 제품 :
K&M DYNASTY Variteks
[CODE: 898 Hinged Stabilizing Knee Brace]

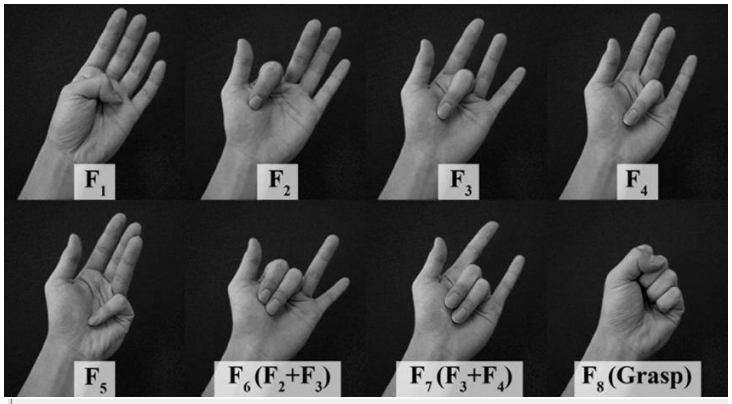
Current Study

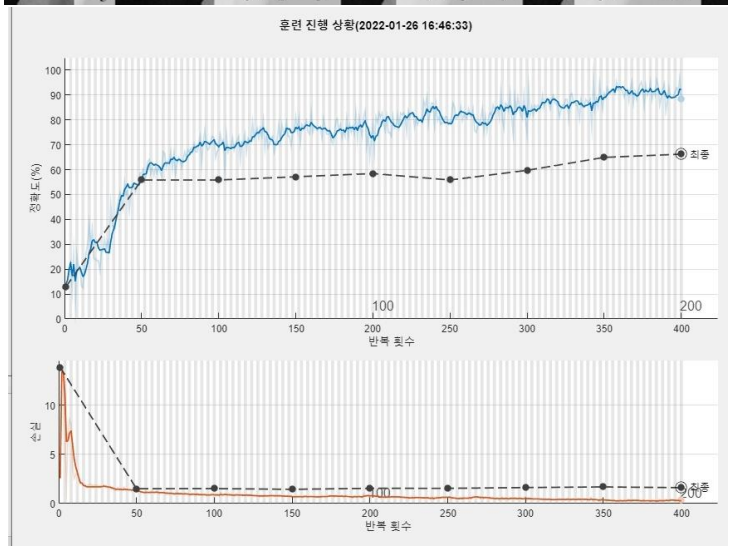
✓ EMG sensor - 4-channel EMG for Finger Gestures Classification





Sample Data

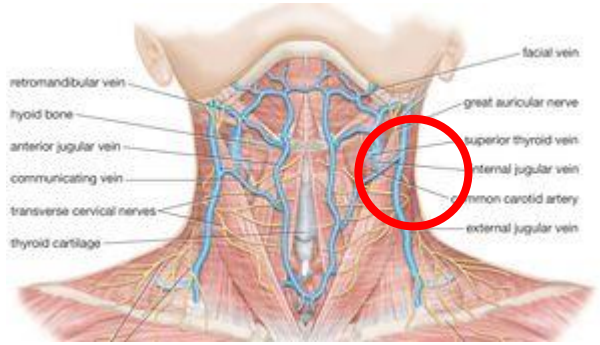


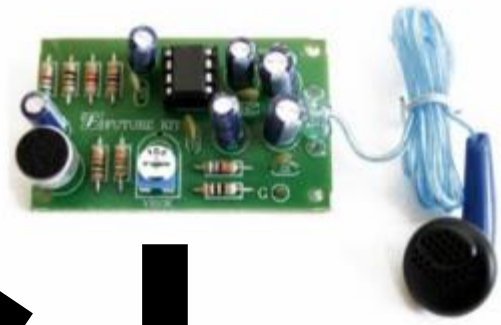


- Code generation for classification Deep learning using Matlab (DeepNetwork Designer)
- Accuracy 70%

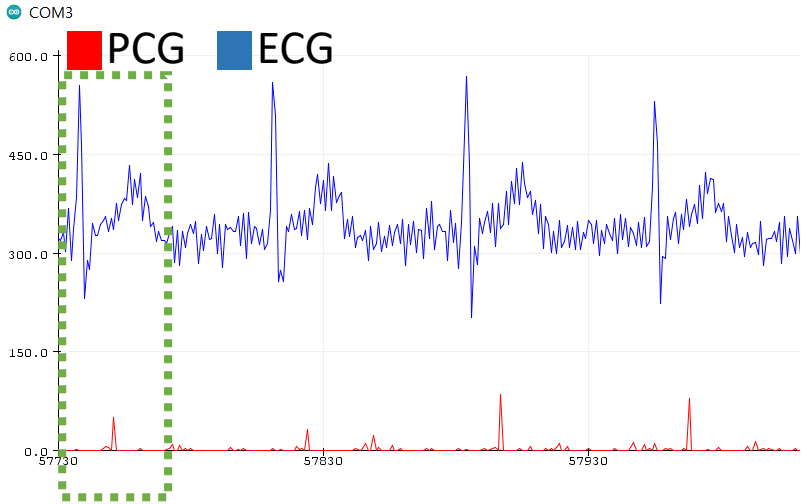
Current Study

✓ PCG sensor –heart sound (S1, S2)





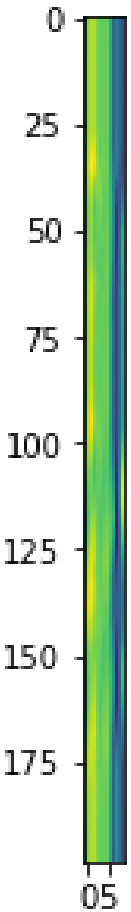
- The only auscultable artery
- In particular, almost identical to the first heart sound(S1)



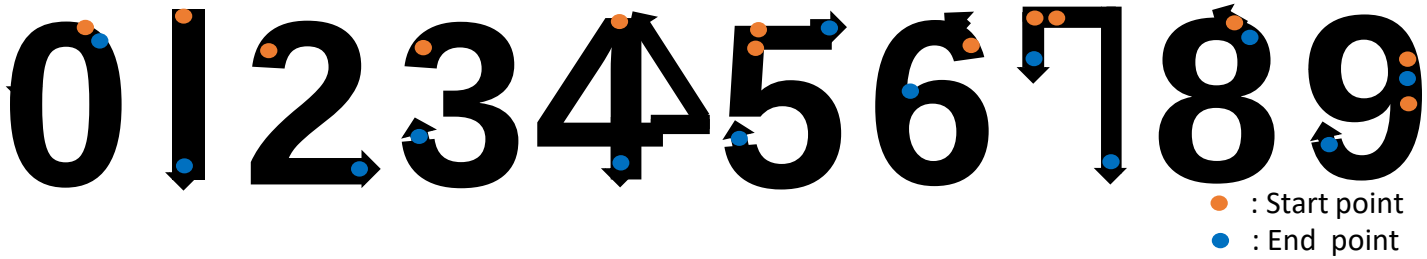
- Fabricating Epidermal sensor
- Attaching the Carotid artery area
- S1, S2 Signal processing

Current Study

✓ IMU sensor – Classification IMU signal (0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9)



Sample Data



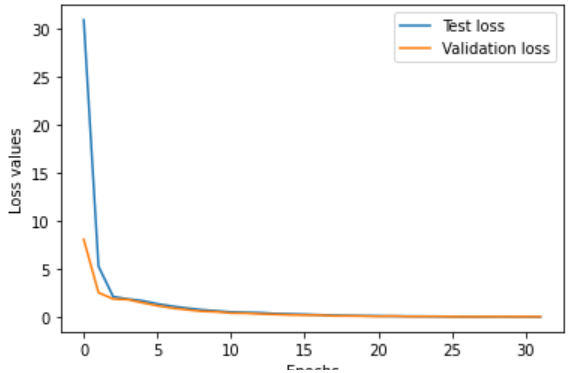
IMU sensor value : 9-axis accel x/y/z gyro x/y/z mag x/y/z

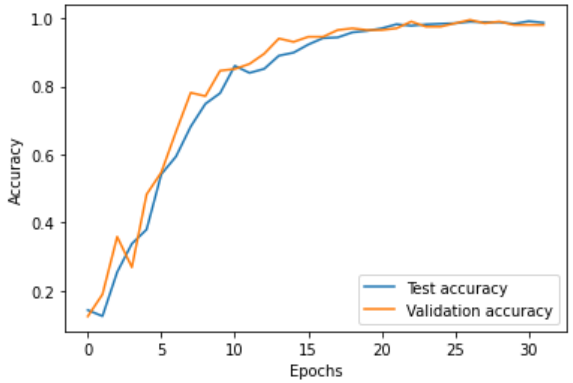
1 Sample data : 4sec

Array : 9 by 199 (convert Color map)

Machine Learning Result

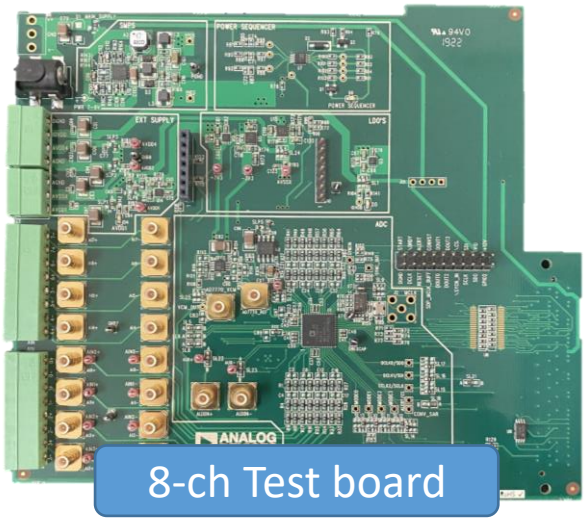
```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
1stCV (Conv2D)               (None, 199, 9, 32)        320
2ndCV (Conv2D)               (None, 199, 9, 64)        18496
Flatten (Flatten)            (None, 114624)            0
1stFC (Dense)                (None, 128)               14672000
2ndFC (Dense)                (None, 64)                8256
lastFC (Dense)               (None, 10)                650
=================================================================
Total params: 14,699,722
Trainable params: 14,699,722
Non-trainable params: 0
_________________________________________________________________
```





Current Study

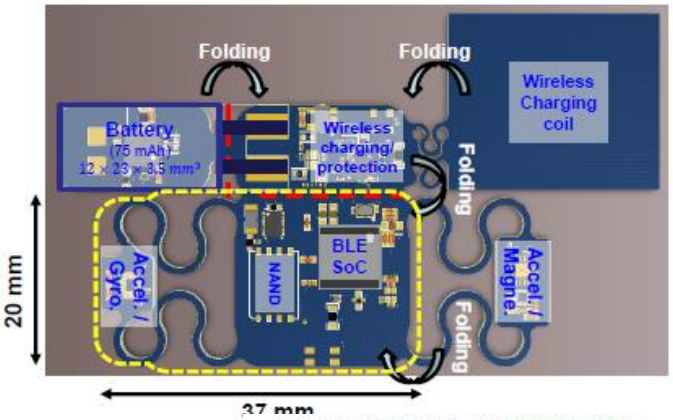
✓ Multi-channel biosignal platform - AD7770

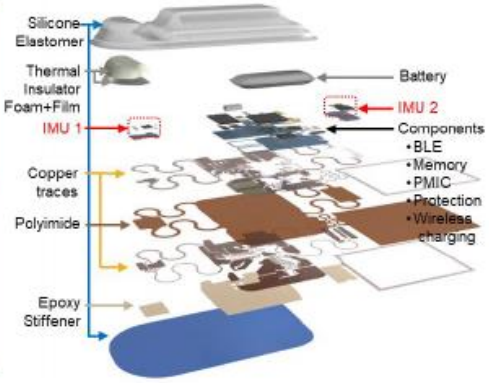


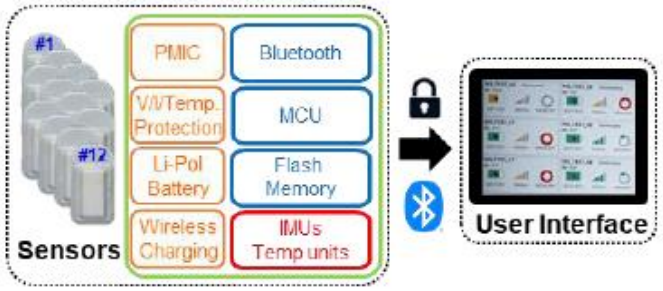
8-ch Test board

- ECG
- PPG
- IMU (I2C)
- SpO_2
- PCG
- EMG
- EEG

Etc….







Thank you