當訊號處理遇上運動科技：打造你的專屬體能監測器

電子一　林黃媛

MOTIVATION

PHYSICAL FITNESS

STRONG YOUR BODY

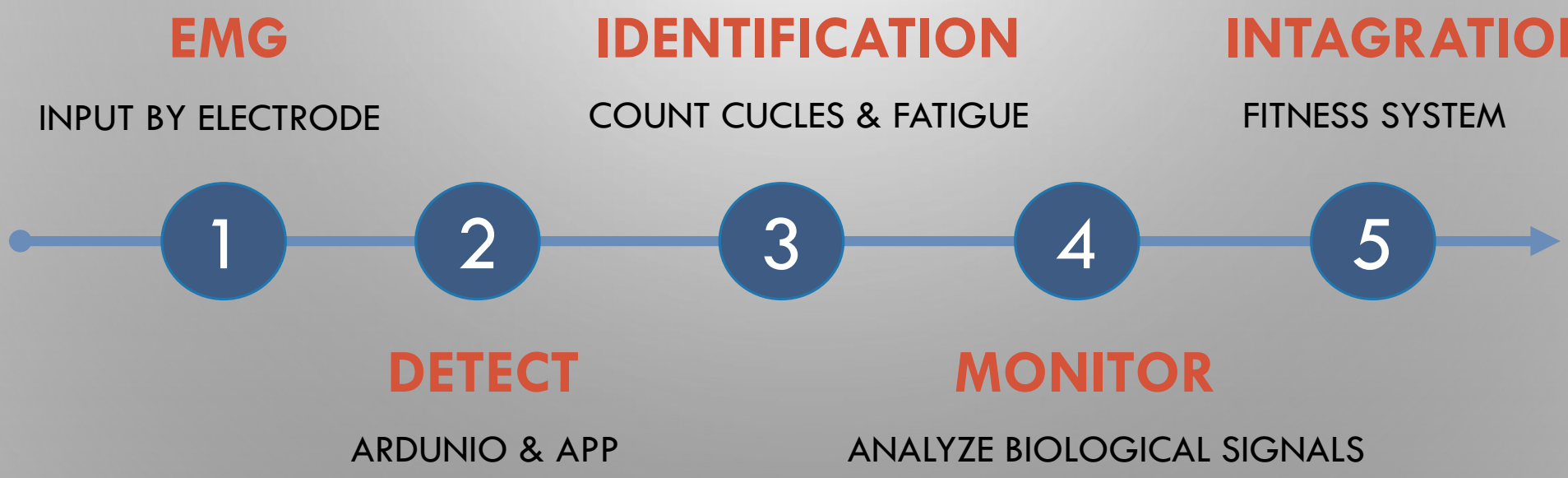
STATISTIC

COLLECT AND INTEGRATE
DATA FROM SENSOR

TRANING OBSERVATION

SET SENSOR 0N YOUR BODY
TO GET INFORMATION

HOW TO REALIZE



PROJECT STRUCTURE

HARDWARE

- EMG MODULE
- EMG CIRCUIT
- MEGA

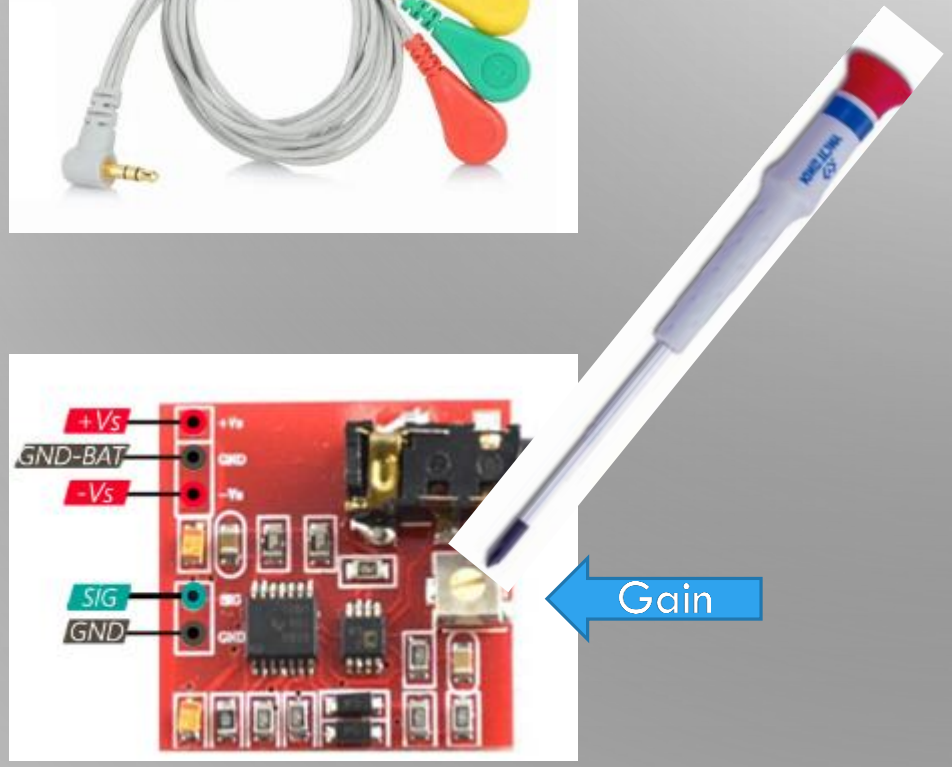
SOFTWARE

- ARDUINO
  a. FATIGUE DETECTION
  b. COUNT
- APP
  a. MODE
  b. COUNT DOWN
- BLUETOOTH

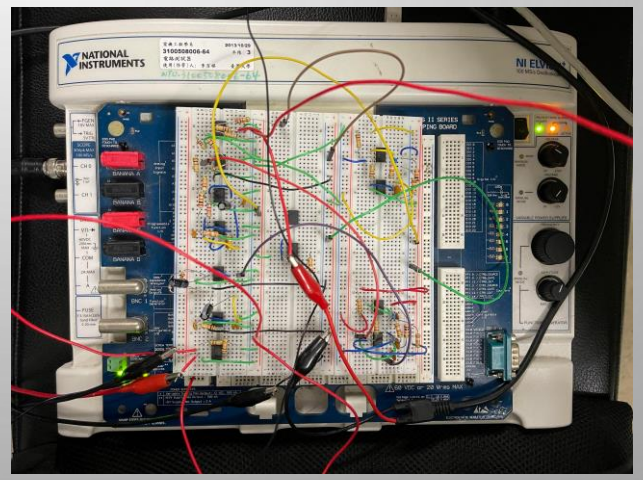
PHYSICAL FITNESS SYSTEM

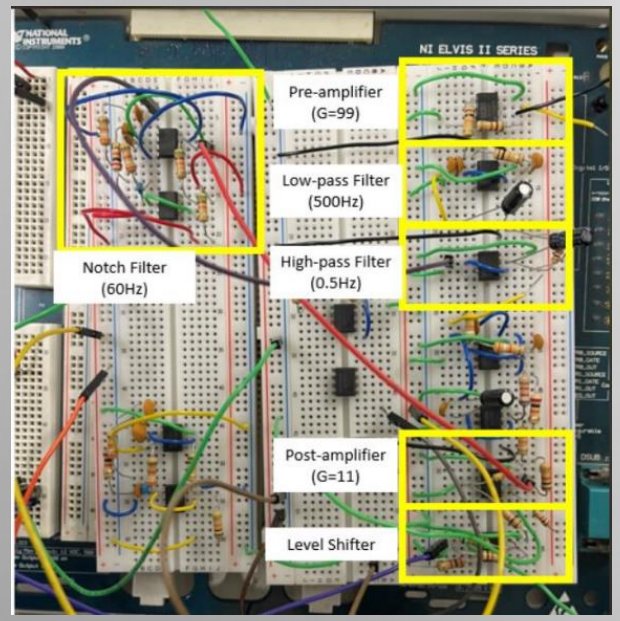
HARDWARE

EMG MODULE



EMG CIRCUIT





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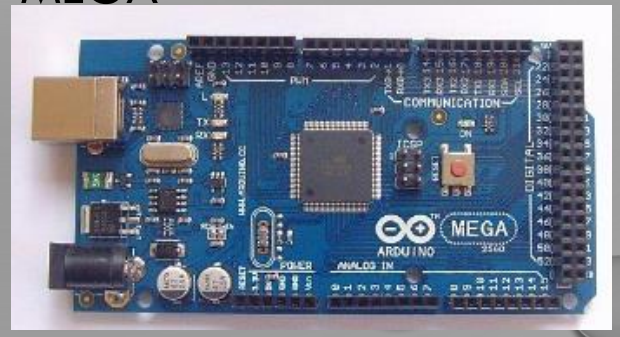
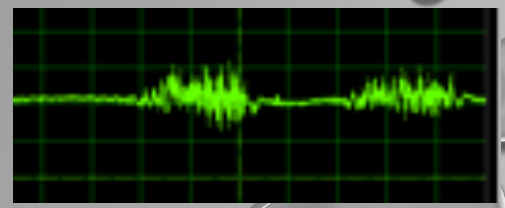
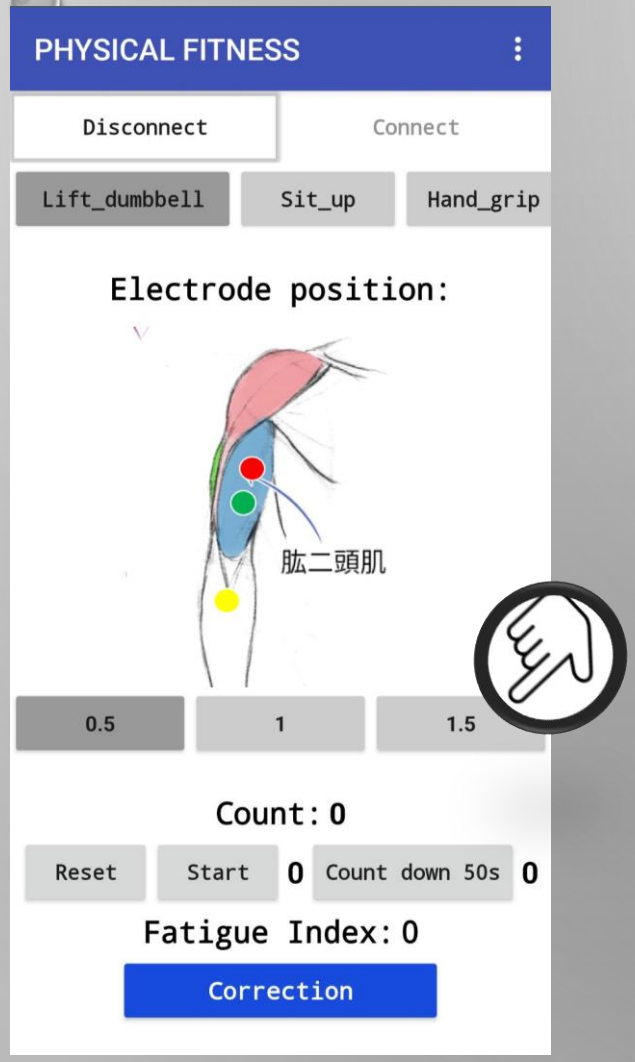




SOFTWARE

- APP INTERFACE
- ARDUINO :1.FOULIER 2. COUNT

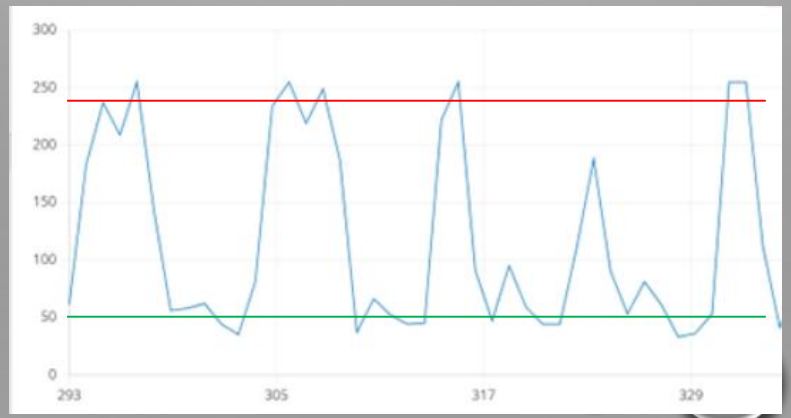
SOFTWARE-COUNT



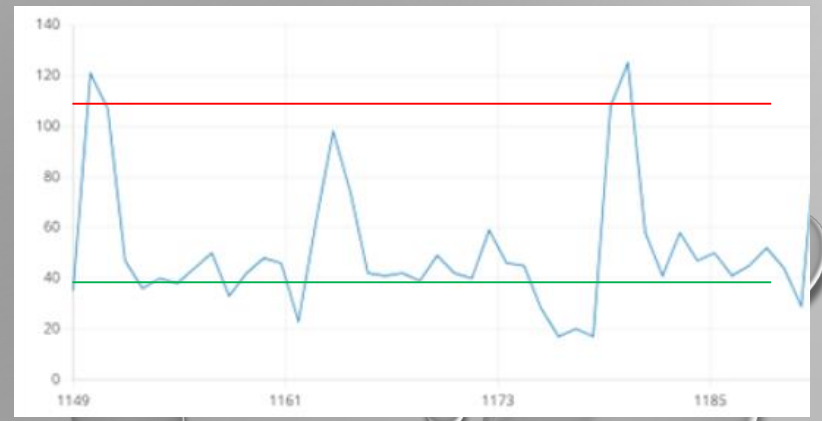
MODE :

TYPE => L, M, S

DUMBBELL



SIT-UP

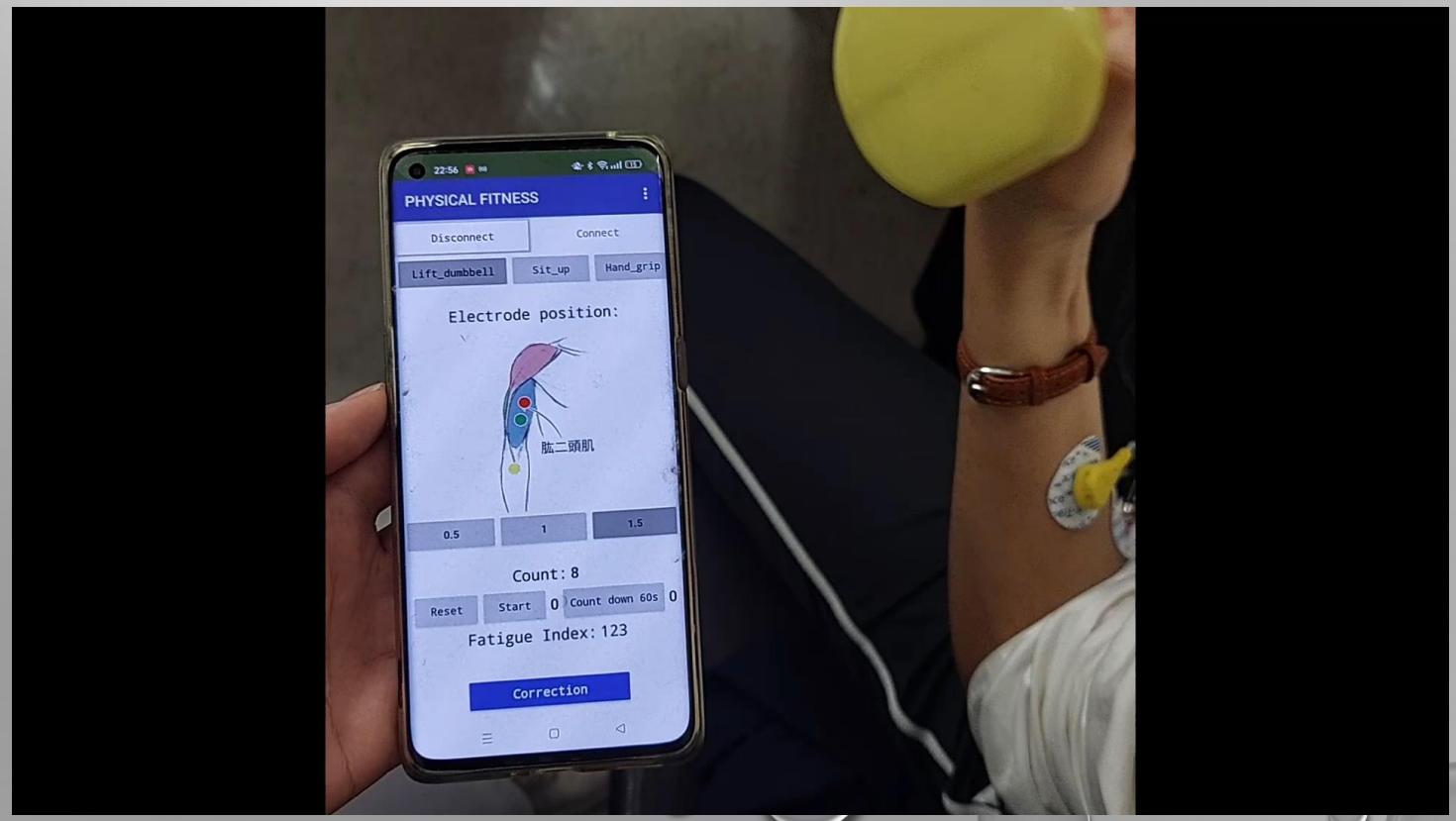


SOFTWARE-COUNT

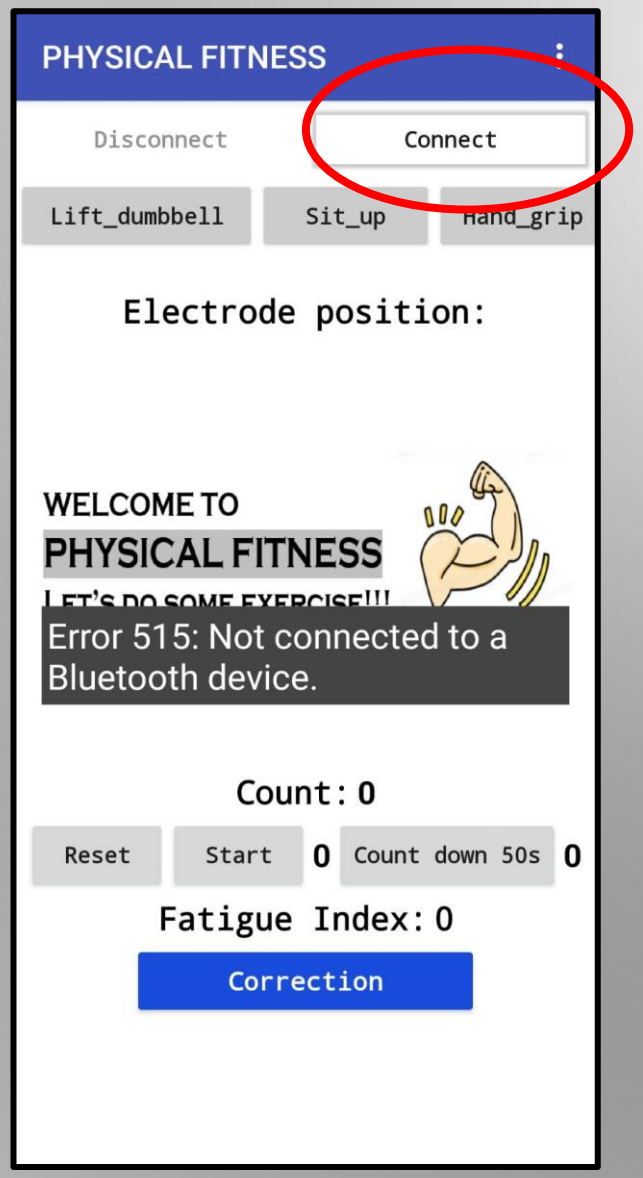
PREVENT OVER COUNT!!!!!!

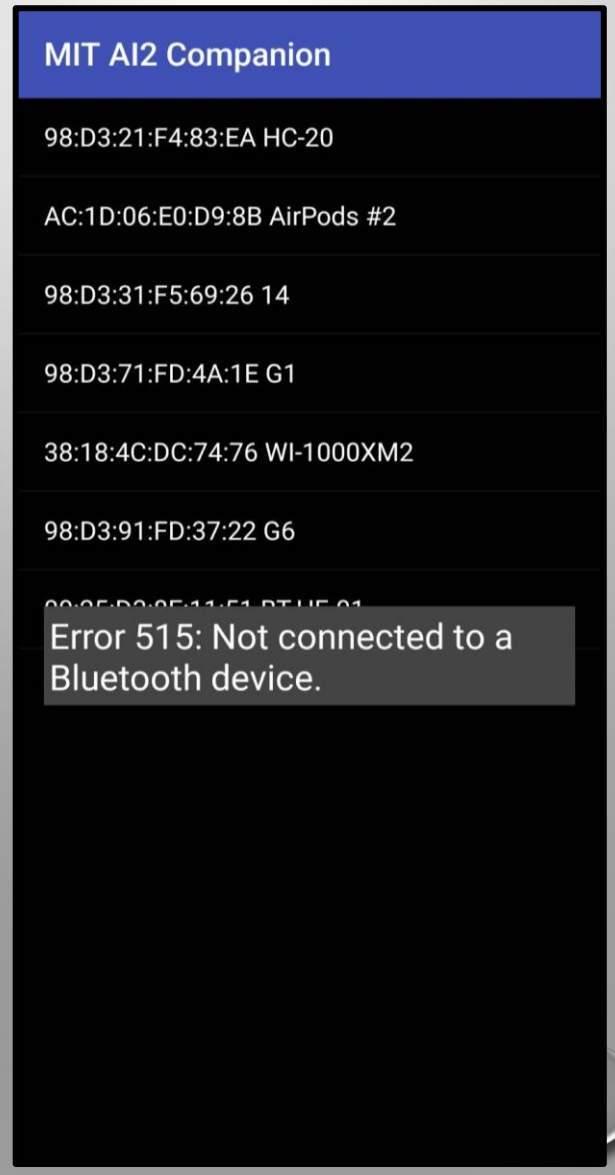
SOFTWARE-COUNT

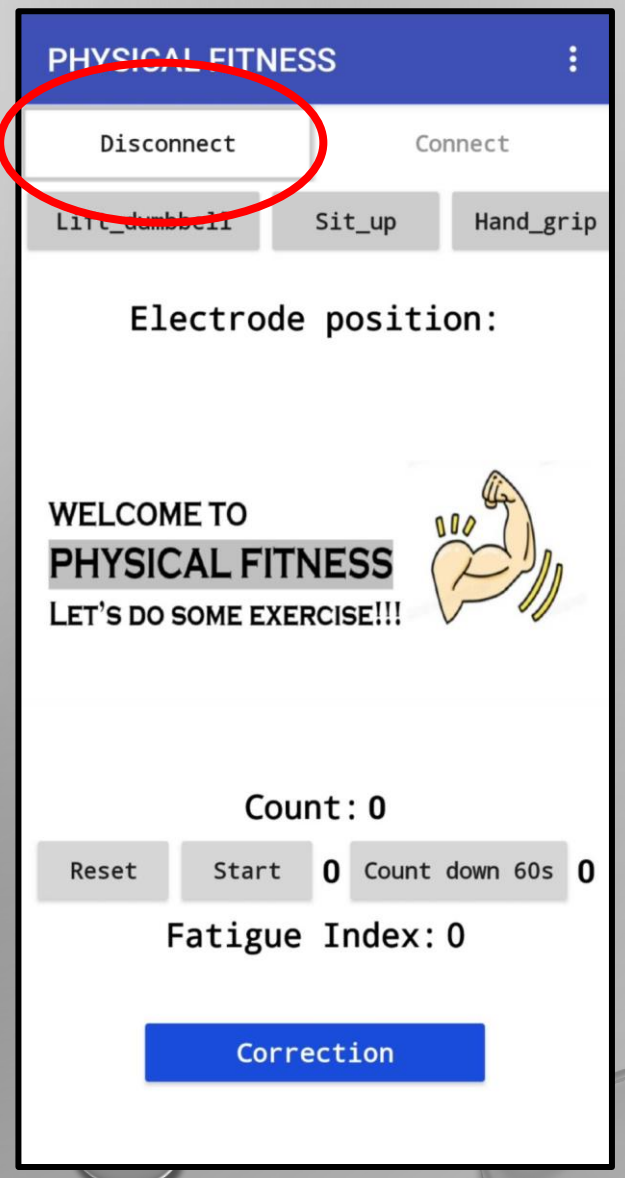
DEMO-DUMBBELL FOR EXAMPLE



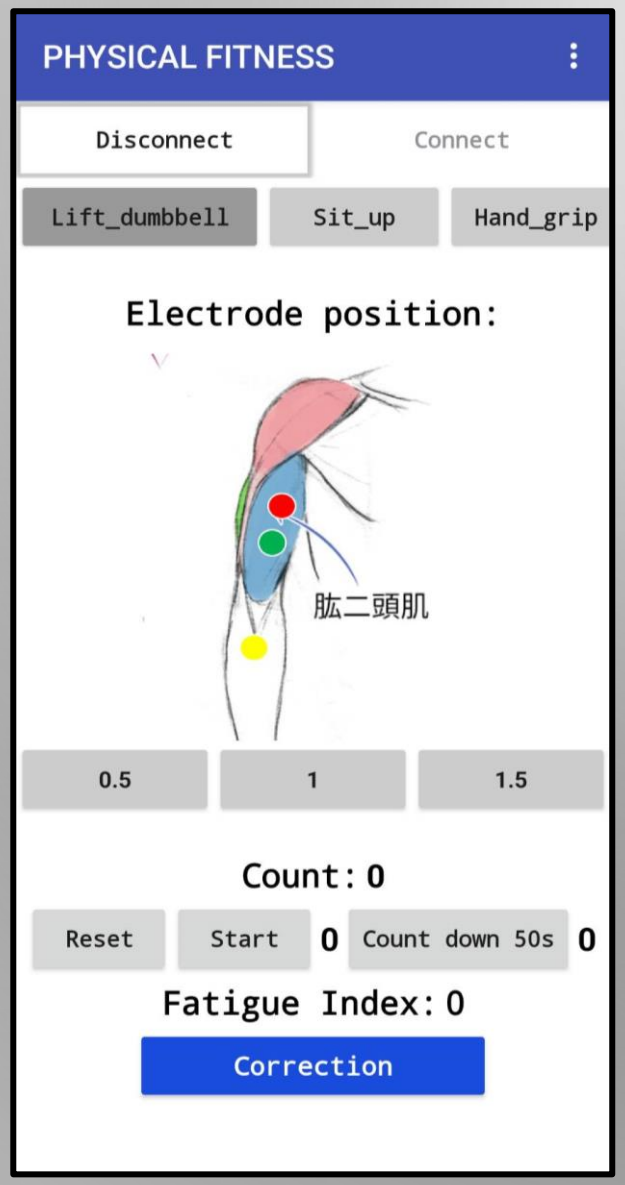
BLUETOOTH CONNECTION

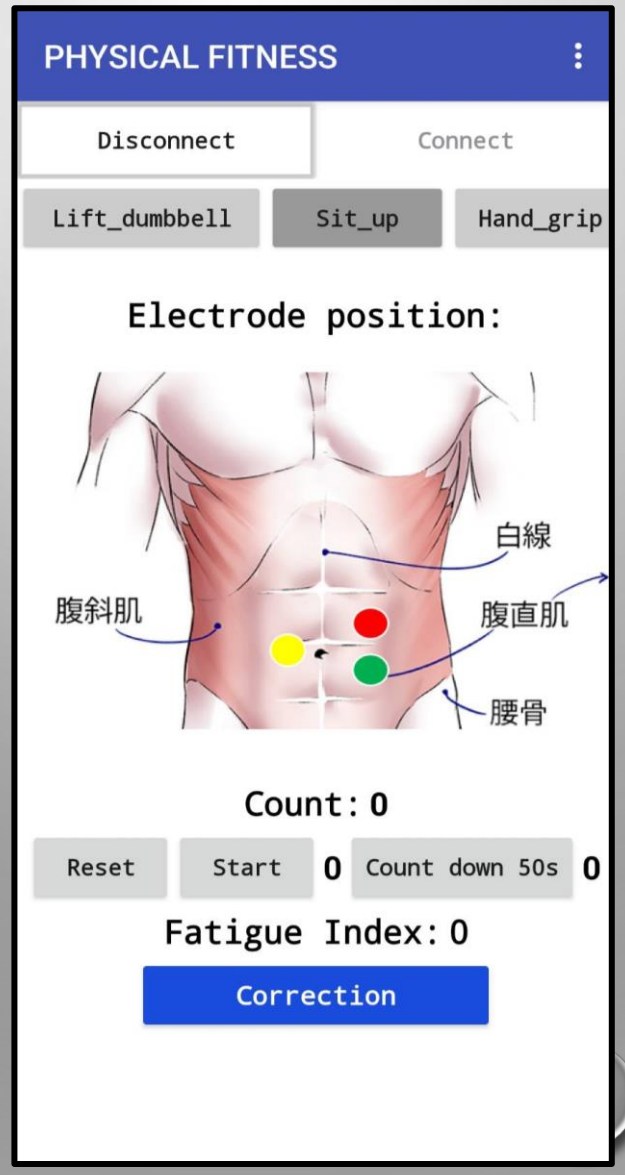


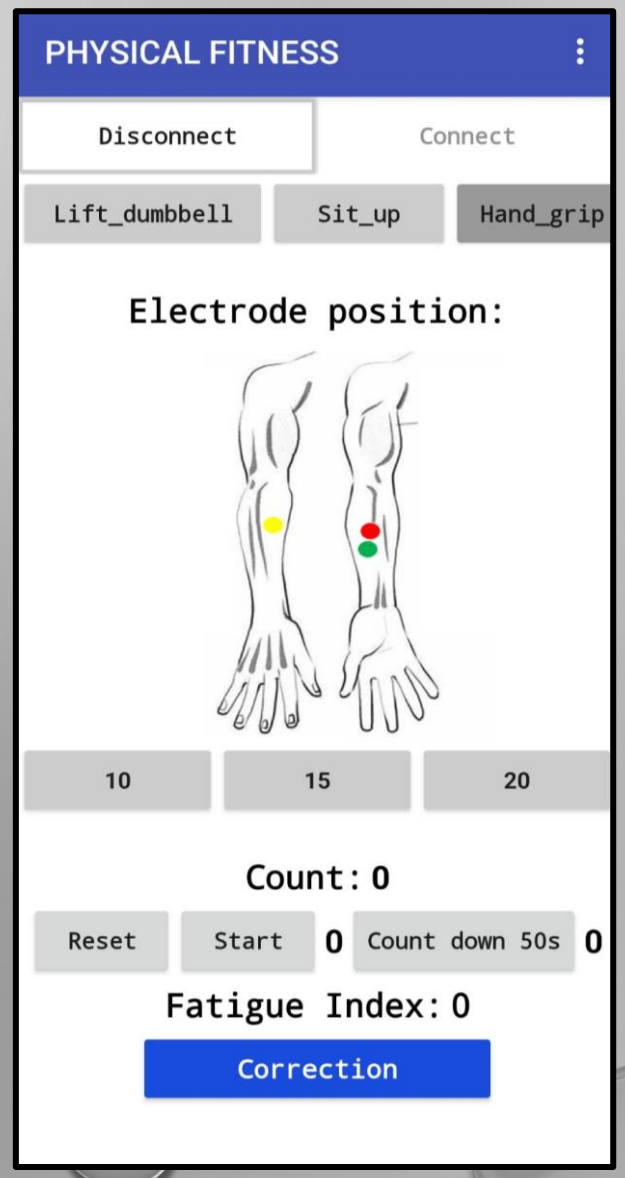




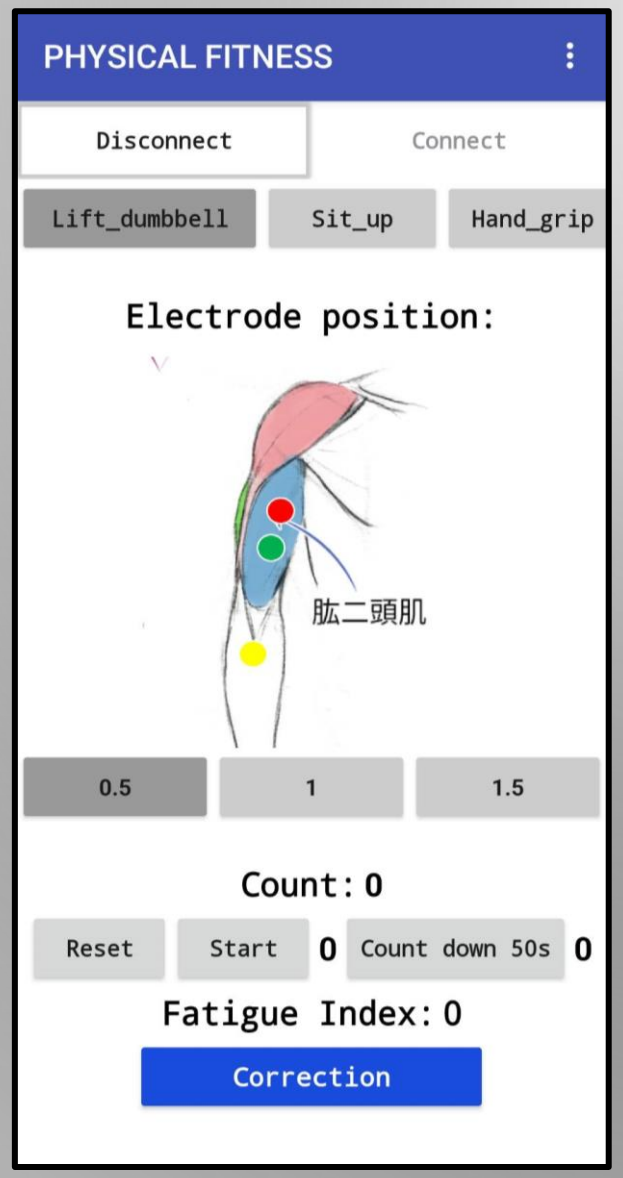
MODE SELECTION

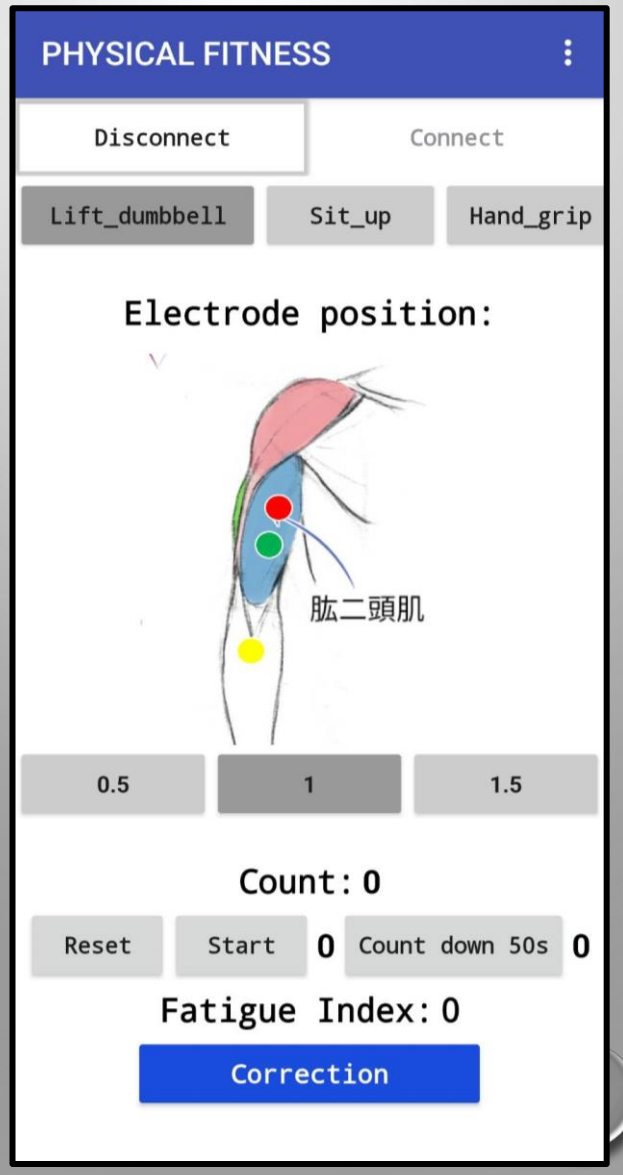


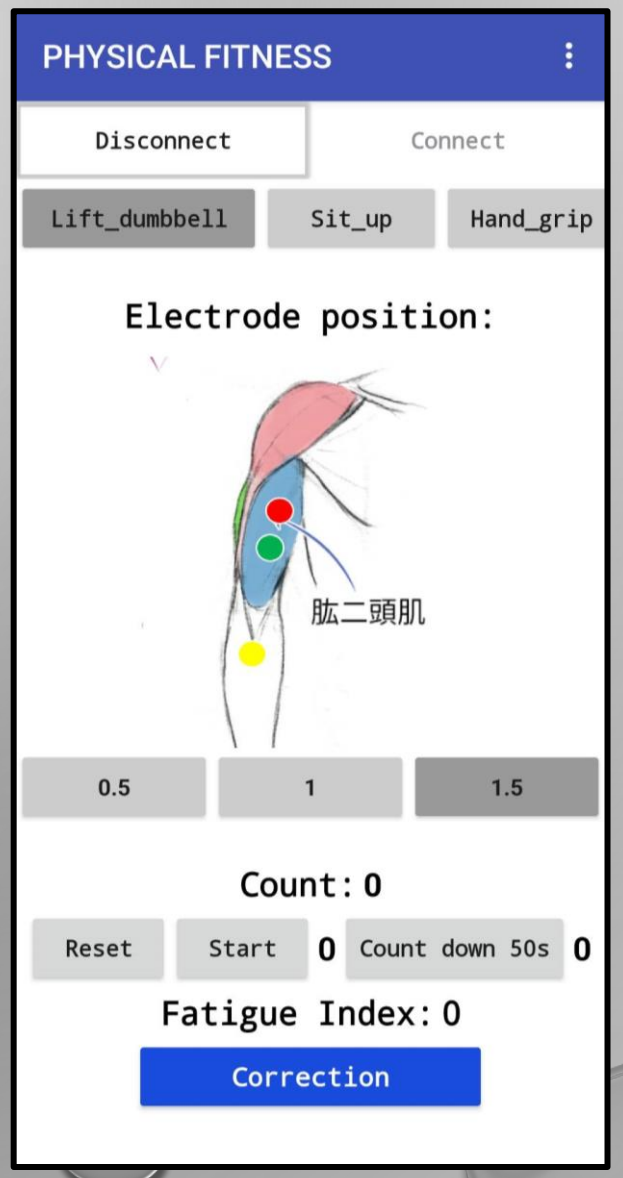




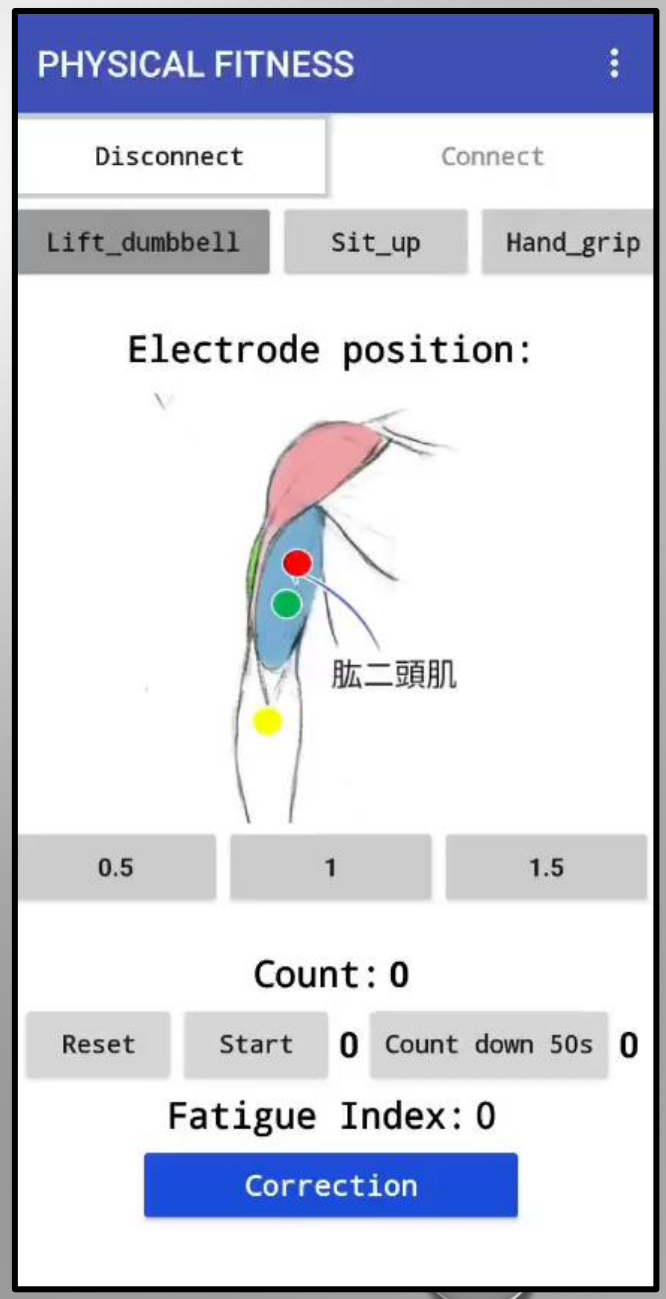
INTENSITY SELECTION

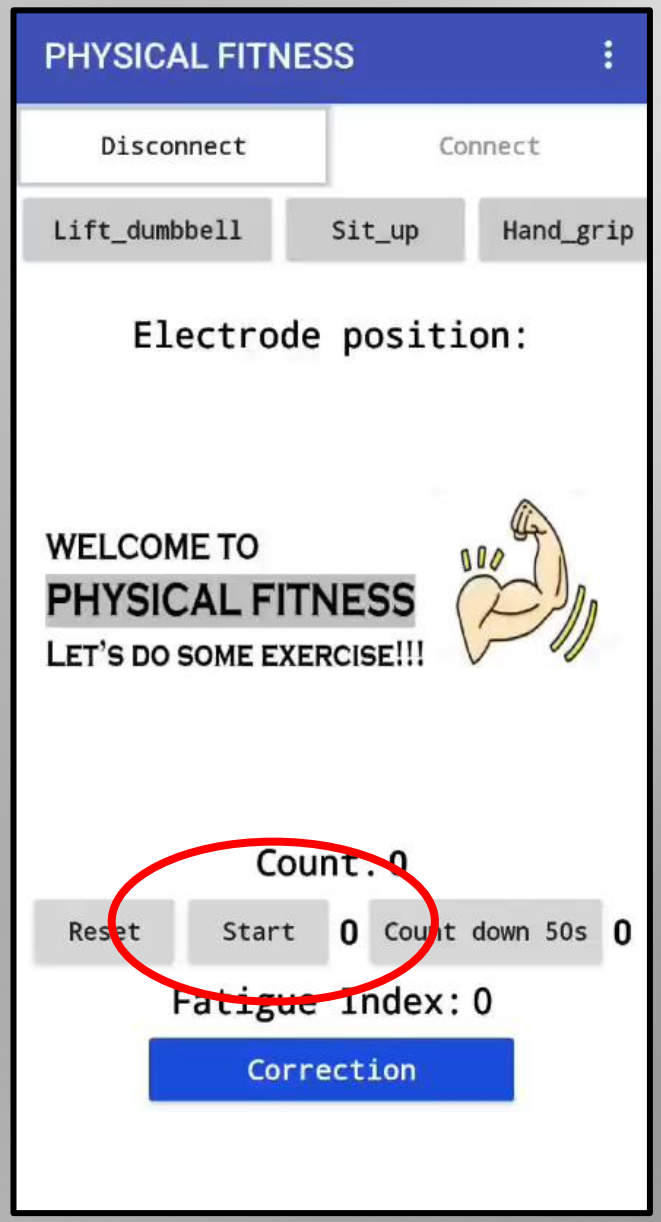


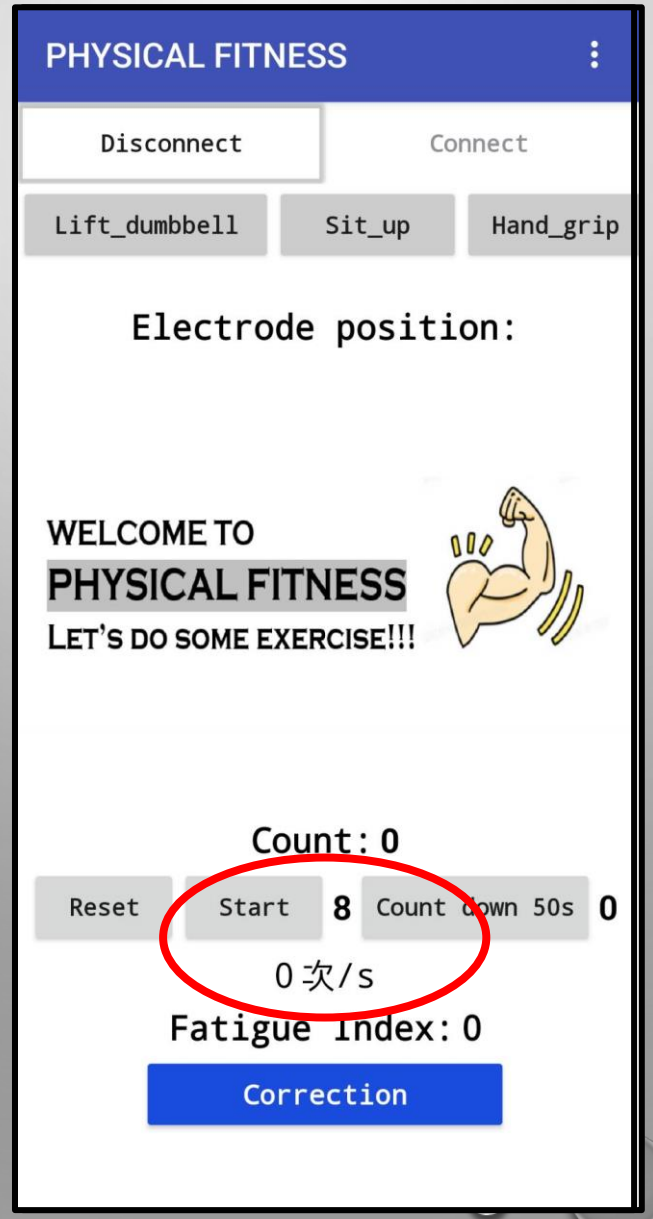




MODE

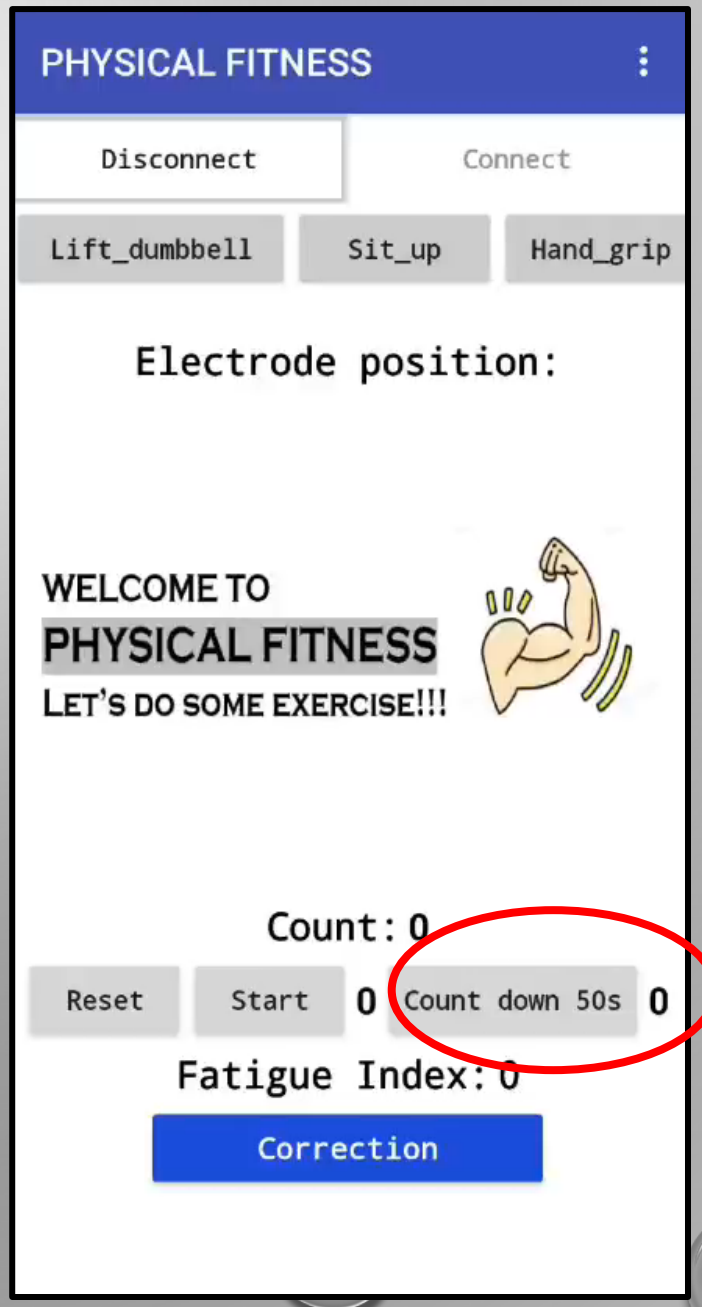

PHYSICAL FITNESS
Disconnect
Connect
Lift_dumbbell
Sit_up
Hand_grip
Electrode position:
肱二頭肌
0.5
1
1.5
Count: 0
Reset
Start
0
Count down 50s
0
Fatigue Index: 0
Correction

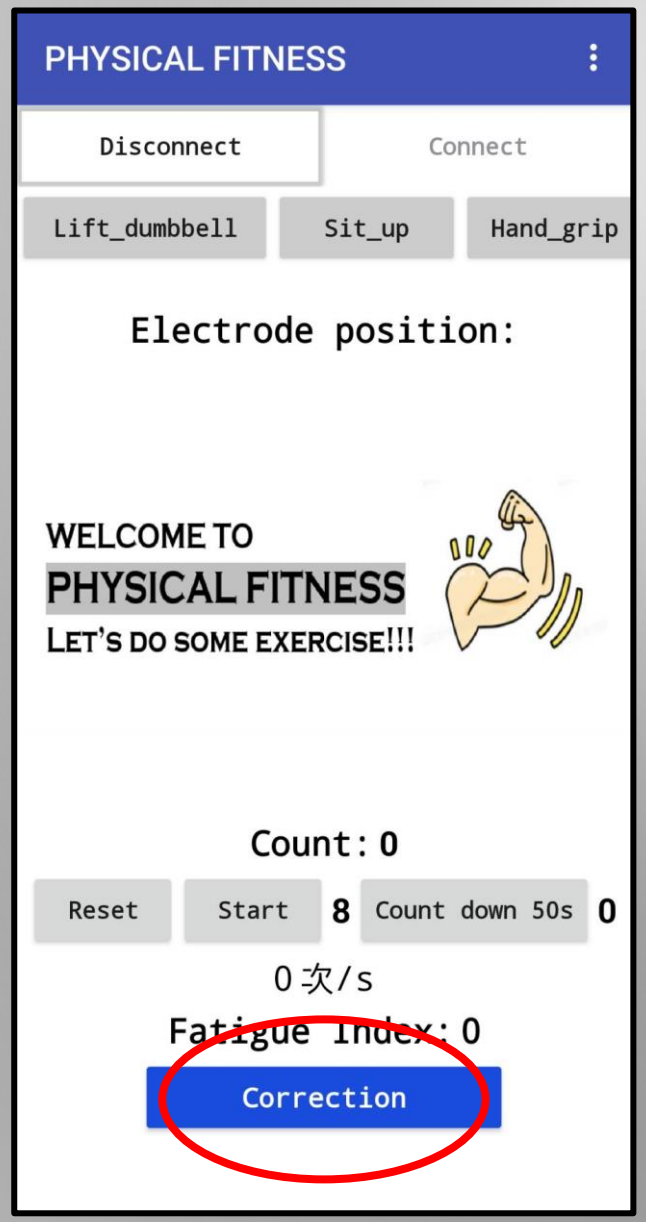

PHYSICAL FITNESS
Disconnect
Connect
Lift_dumbbell
Sit_up
Hand_grip
Electrode position:
WELCOME TO
PHYSICAL FITNESS
LET'S DO SOME EXERCISE!!!
Count: 0
Reset
Start
0
Count down 50s
0
Fatigue Index: 0
Correction


PHYSICAL FITNESS
Disconnect
Connect
Lift_dumbbell
Sit_up
Hand_grip
Electrode position:
WELCOME TO
PHYSICAL FITNESS
LET'S DO SOME EXERCISE!!!
Count: 0
Reset
Start
8
Count down 50s
0
0 次/s
Fatigue Index: 0
Correction

TIMER

COUNT DOWN

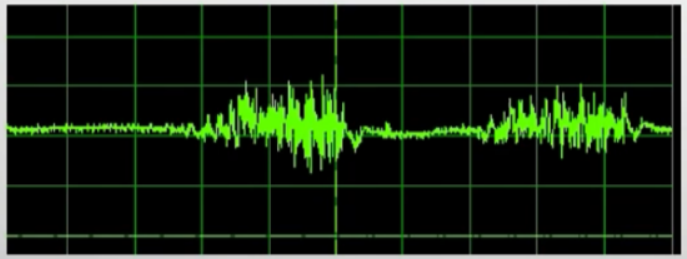

PHYSICAL FITNESS
Disconnect
Connect
Lift_dumbbell
Sit_up
Hand_grip
Electrode position:
WELCOME TO
PHYSICAL FITNESS
LET'S DO SOME EXERCISE!!!
Count: 0
Reset
Start
0
Count down 50s
0
Fatigue Index: 0
Correction

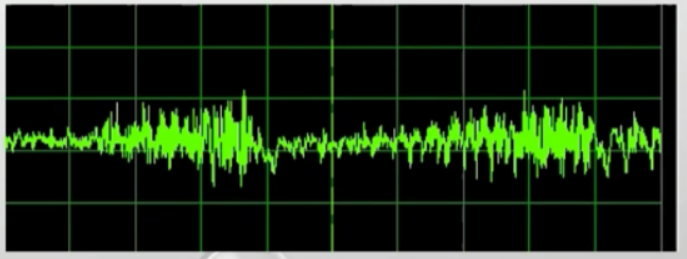

PHYSICAL FITNESS
Disconnect
Connect
Lift_dumbbell
Sit_up
Hand_grip
Electrode position:
WELCOME TO
PHYSICAL FITNESS
LET'S DO SOME EXERCISE!!!
Count: 0
Reset
Start
8
Count down 50s
0
0 次/s
Fatigue Index: 0
Correction

CORRECTION

SOFTWARE-FATIGUE DETECTION

1. Observation:
   - Muscle stiffness due to muscle fatigue slows down the transmission speed between muscle fibers, resulting in a less distinct potential difference. Thus, after the muscles are more fatigued (after many experiments), the EMG signals between each movement are less obvious.
   - Counting number of times become more difficult. Also, it may be interference by noise more easily.





SOFTWARE-FATIGUE DETECTION

- In the frequency domain, fatigue causes the transmission speed between muscle fibers to slow down, and the discharge frequency of the motor unit decreases, causing the spectrum distribution to gradually concentrate at low frequencies.

➔ We decide to use frequency domain to detect fatigue.

SOFTWARE-FATIGUE DETECTION

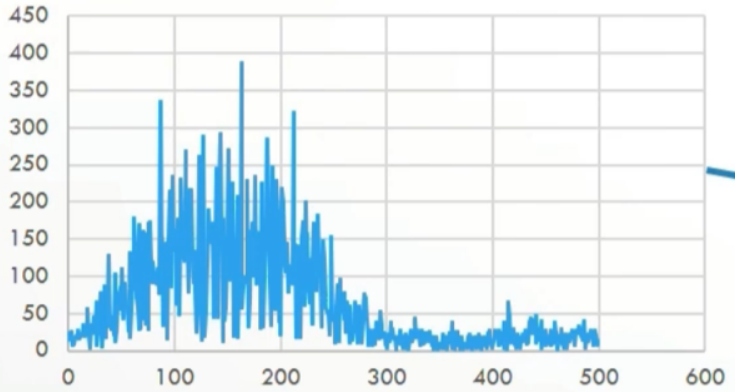
2. Consideration:

The ideal measurement muscles we choose must consider the following conditions:

(1) The muscle area is large enough, the location is easy to find, and the electrode patches are easy to place.

(2) Muscles with the most obvious and clear amount of exercise during action execution, so as to obtain the most ideal and representative characteristic values.

(3) Those who are not interfered by other.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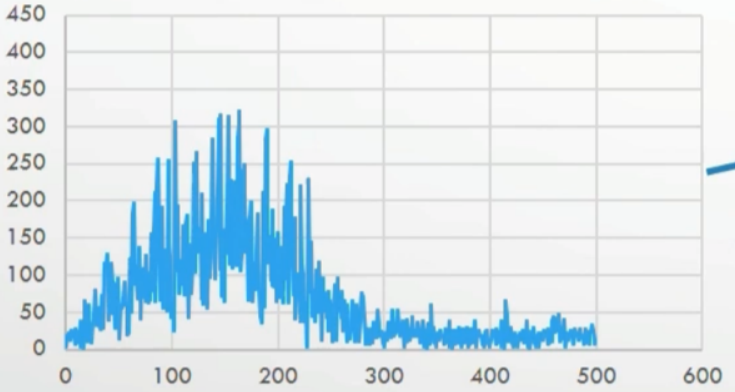
500
600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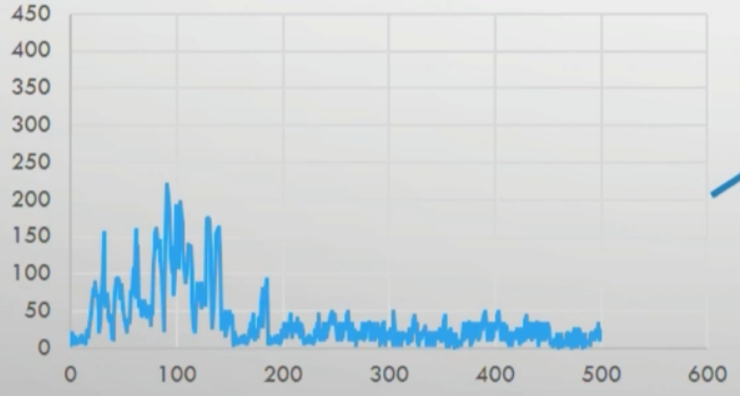
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150
100
50
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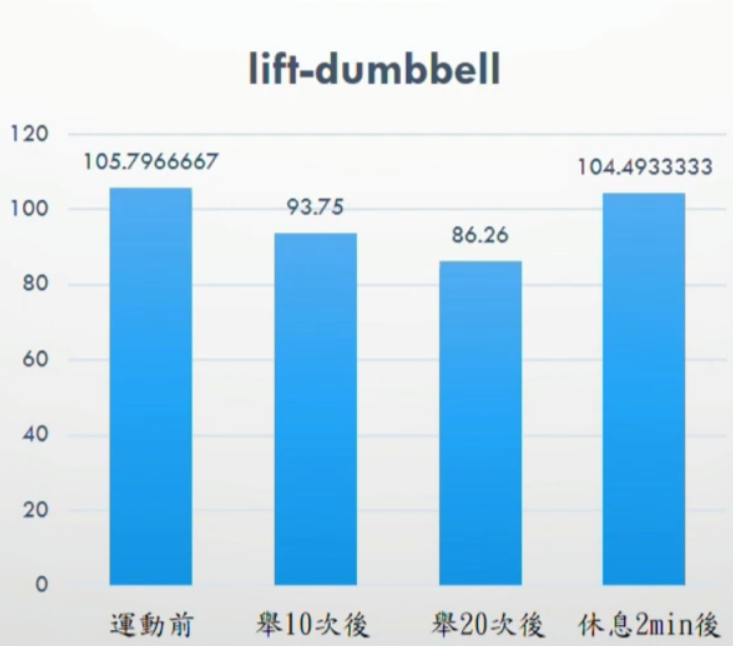
500
600

SOFTWARE-FATIGUE DETECTION

3. Test: Test if MDF will decrease when fatigue. (512 points,1000Hz)



SOFTWARE-FATIGUE DETECTION

4. Implementation
   - Choose 1000 Hz as sample frequency, and record 512 sampling points. (about 0.5s)
   - When the EMG value reach the threshold, start record the points.
   - Do fourier transform when count=1, then analyze the spectrum to find the initial MDF.
   - Then, get the MDF every 10 times to detect fatigue.
   - Show the result on the APP to check if MDF decreased. We defined it as fatigue index.

REFERENCE

- HTTPS://IR.NCTU.EDU.TW/BITSTREAM/11536/78315/4/262404.PDF
- HTTPS://IR.NCTU.EDU.TW/BITSTREAM/11536/68468/9/255109.PDF
- HTTP://BIMELAB.BLOGSPOT.COM/2006/12/EMGFREQUENCY-DOMAINMEDIANFREQUENCY.HTML
- HTTP://CC.EE.NTU.EDU.TW/~ULTRASOUND/BELAB/TERM_PROJECT/GROUP8/106-2-
- FINAL_G08.PDF
- HTTPS://WWW.INSTRUCTABLES.COM/EASYFFT-FREQUENCY-TRANSFORM-FORARDUINO/?FBCLID=IWAR1HWANPPJNIP45K1JVUEGVHZEBE7FUCITGOKFVKSSTQNI-P32LPDC57L0

THANK YOU FOR YOUR LISTENING

- SPECIAL THANKS TO MY PROJECT COLLABORATOR, C. Y. LEE AND H. -X. SHIH FOR THEIR GREAT SUPPORT AND COLLABORATION THROUGHOUT THIS PROJECT.