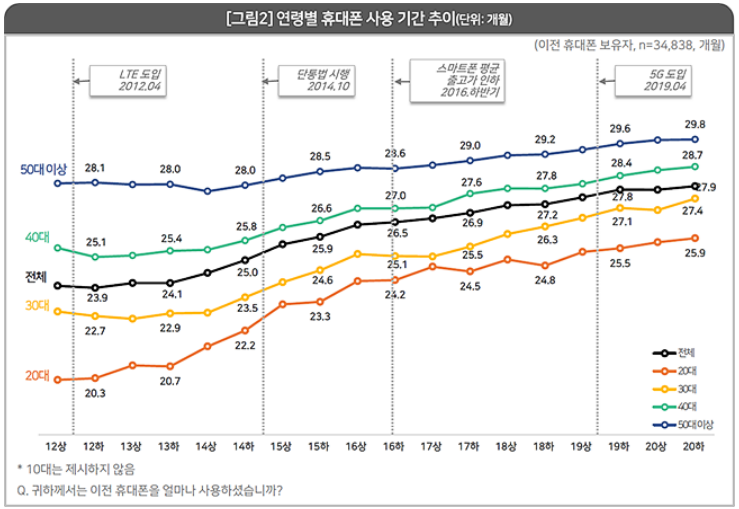
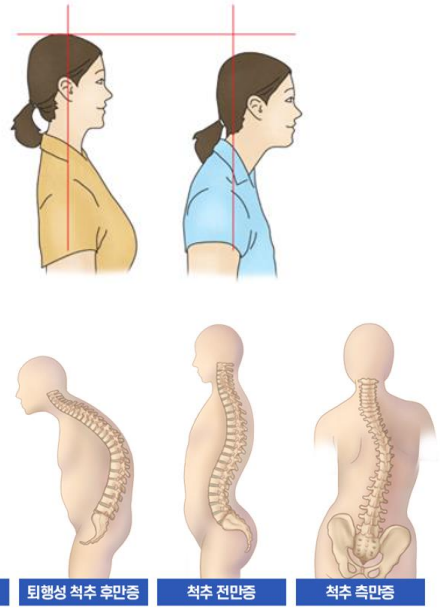
# 재활 치료 운동 자세 가이드

박세현
장지수
반지훈

# Contents

# Problem Definition




스마트폰 사용량 및 전자기기 사용량 증가

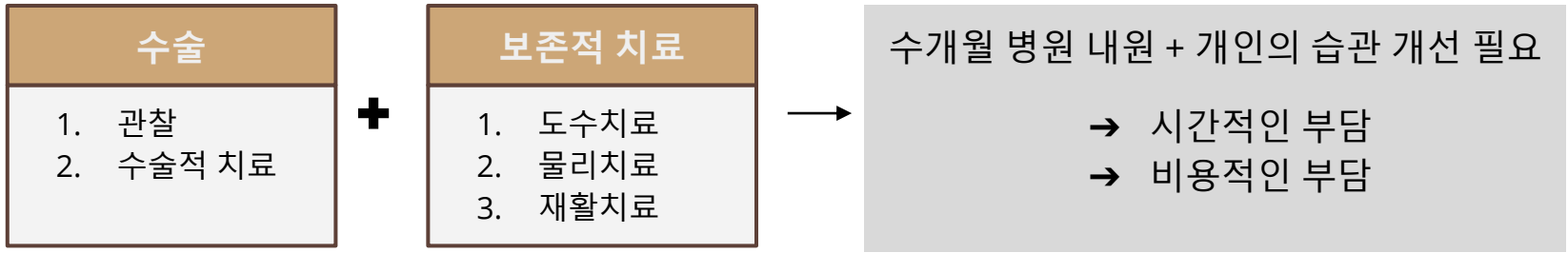
근골격계 질환 환자 증가

중증 상체 근골격계 질환 뿐만 아니라

거북목, 척추 측만증 등 경도의 질환 환자 증가

# Problem Definition

- 근골격계 질환 치료 방법




환자 개인이 스스로 본인을 촬영하는 것과
동시에 올바른 자세 예시를 보면서 운동 자세를 할 수 있을까?

➔ 재활 운동 자세를 가이드 하는 시스템을 만들자!

# Related Work

**Venture**

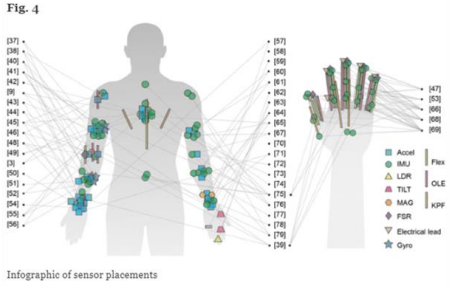
- 운동 가이드 어플리케이션
- 자세에 대한 피드백 + 올바른 자세 예시 부족

**Research**

- Kinect, Vicon과 같은 센서에 의존
- 개인의 사용보다 병원용 사용에 초점

kaia health™

Artificial Intelligence-Based Wearable Robotic Exoskeletons for Upper Limb Rehabilitation: A Review

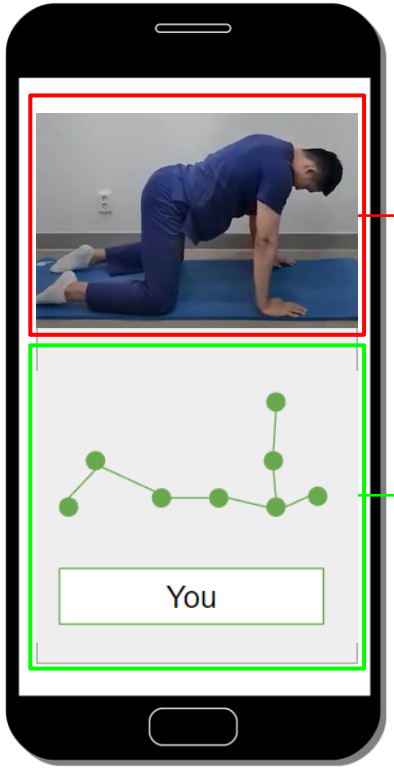
# Target Scenario

**User Interface**

- 실제 올바른 동작 제시
- 본인의 관절 좌표 제시

**Model**

- Kinect Sensor을 이용한 관절 좌표 데이터 학습
- 실시간으로 모델이 사용자의 자세가 제대로 이루어지는지 판단

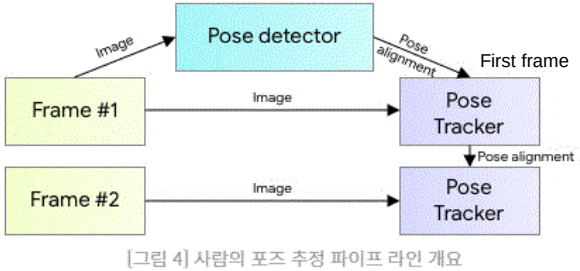



따라할 수 있는 동작 영상

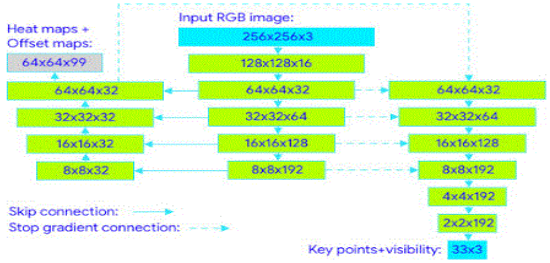
Pose Detection: 사용자 관절 좌표와 관절 간 각도 계산 후 올바른 동작인지 판별

# Mediapipe

- Using Blazepose to track the real-time body pose to predict the location 33 keypoints
  - Estimation: Utilize two-step detector tracker ML pipeline
    - Find the pose Region-of-interest (ROI)
      - Video case: run only first frame
    - Pose Estimation Component
      - Three degrees of freedom: x,y location and visibility two virtual alignment keypoints
- Pose Detection by Extending BlazeFace
  - Trained a face detector as a proxy for a pose detector
- Combined heat map/offset prediction of all keypoints
  - Employ a heatmap and offset loss to train the center and left tower of the network
  - Remove the heatmap output and train the regression encoder
  - Heatmap to supervise a lightweight embedding



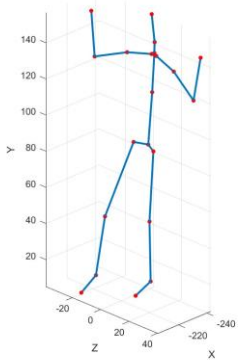

[그림 4] 사람의 포즈 추정 파이프 라인 개요




[그림 6] 네트워크 아키텍처 추적 : 히트맵 주도를 통한 회귀

# Target Scenario

(e) m05




(e) m05

**Dataset**

Labelling된 Kinect 3D 관절 좌표 위치

**Model**

올바른 Landmark 위치 좌표 학습된 mediapipe 모델

**Application**

사용자 재활 운동 시작

**Landmark 좌표 추출**

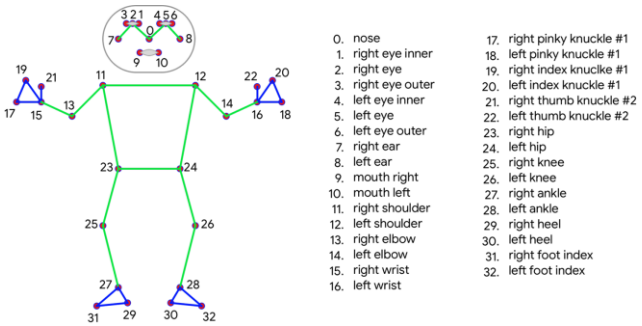
사용자에게서 Model이 학습한 landmark 좌표 추출 & 올바른 좌표와 비교

**피드백**

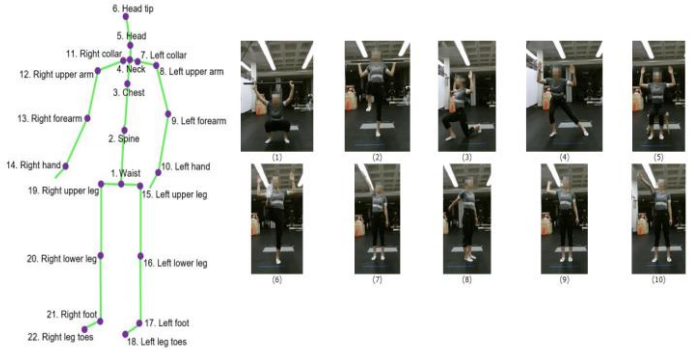
올바른 동작을 수행했다

# Technical Challenges

프로젝트 초기 방향




Landmark 수정




Mediapipe

ML Solution using BlazePose for extracting coordinates from human

UI-PRMD: Kinect Coordinate

15 Healthy, 14 Unhealthy Subject, 10 movements, 10 Repetition, Label on Correct Movement

# Technical Challenges

API 전체를 수정해야 하는 문제

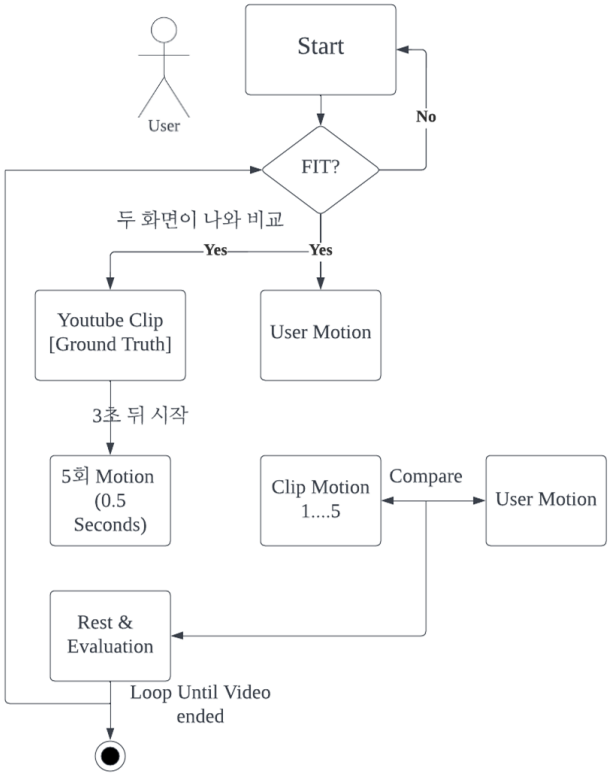
Mediapipe

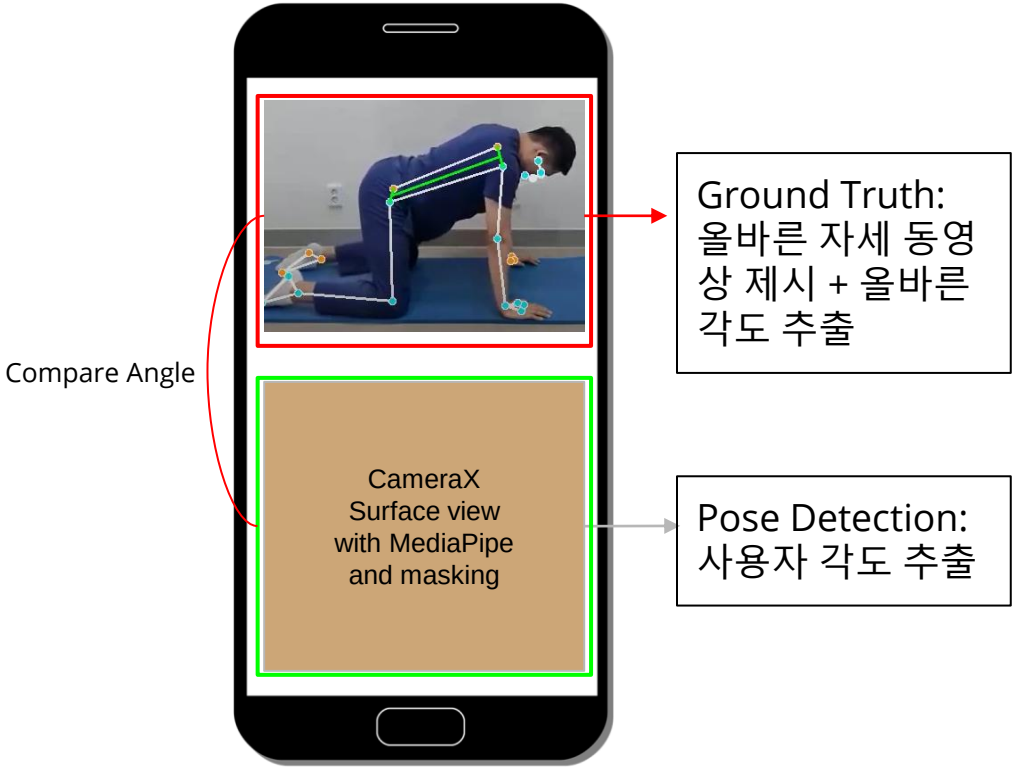
ML Solution using BlazePose for extracting coordinates from human

UI-PRMD: Kinect Coordinate

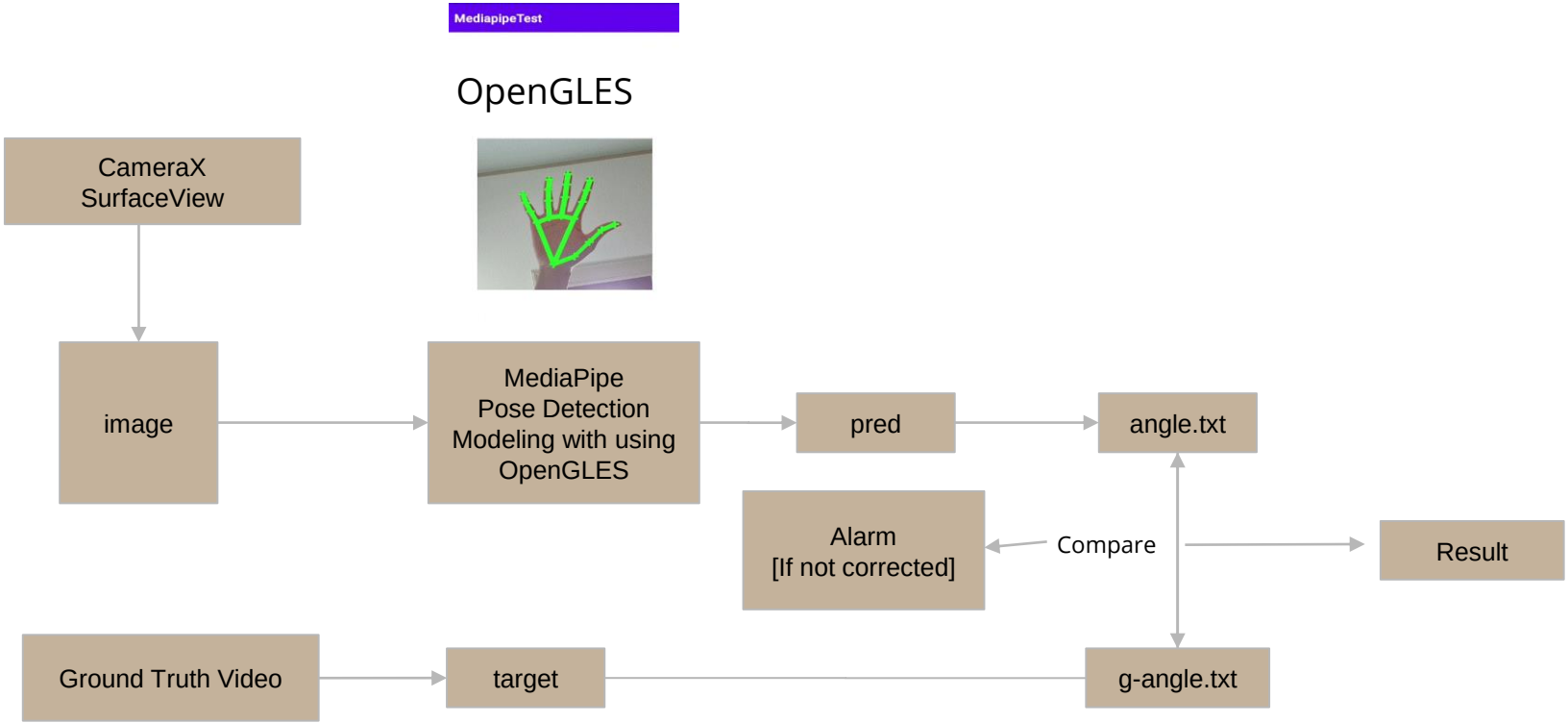
15 Healthy, 14 Unhealthy Subject, 10 movements, 10 Repetition, Label on Correct Movement

# Application Architecture [User Case]

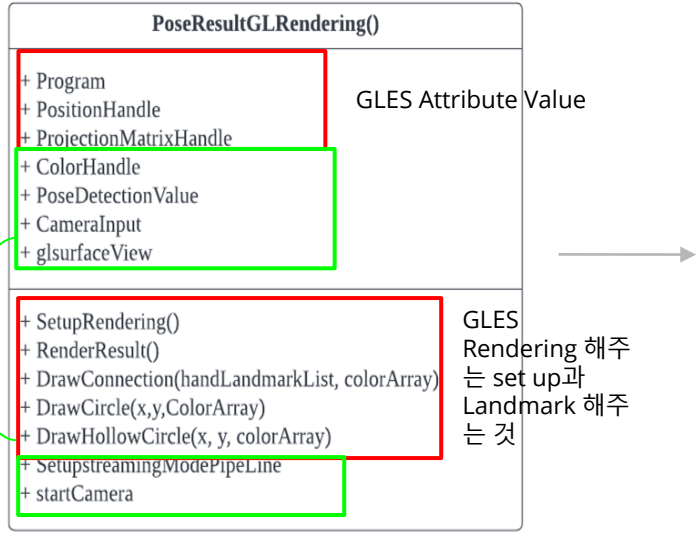


# Application Architecture [초기]



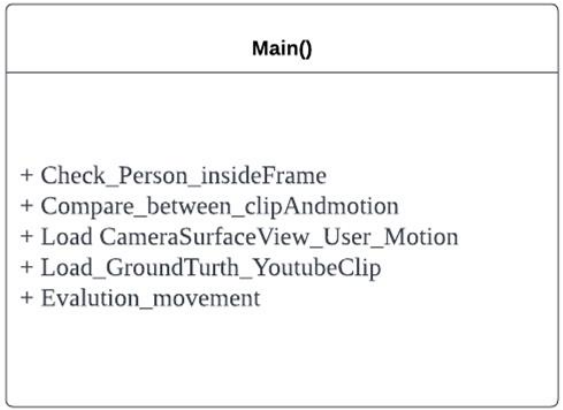
# Application Architecture




GLES Attribute Value

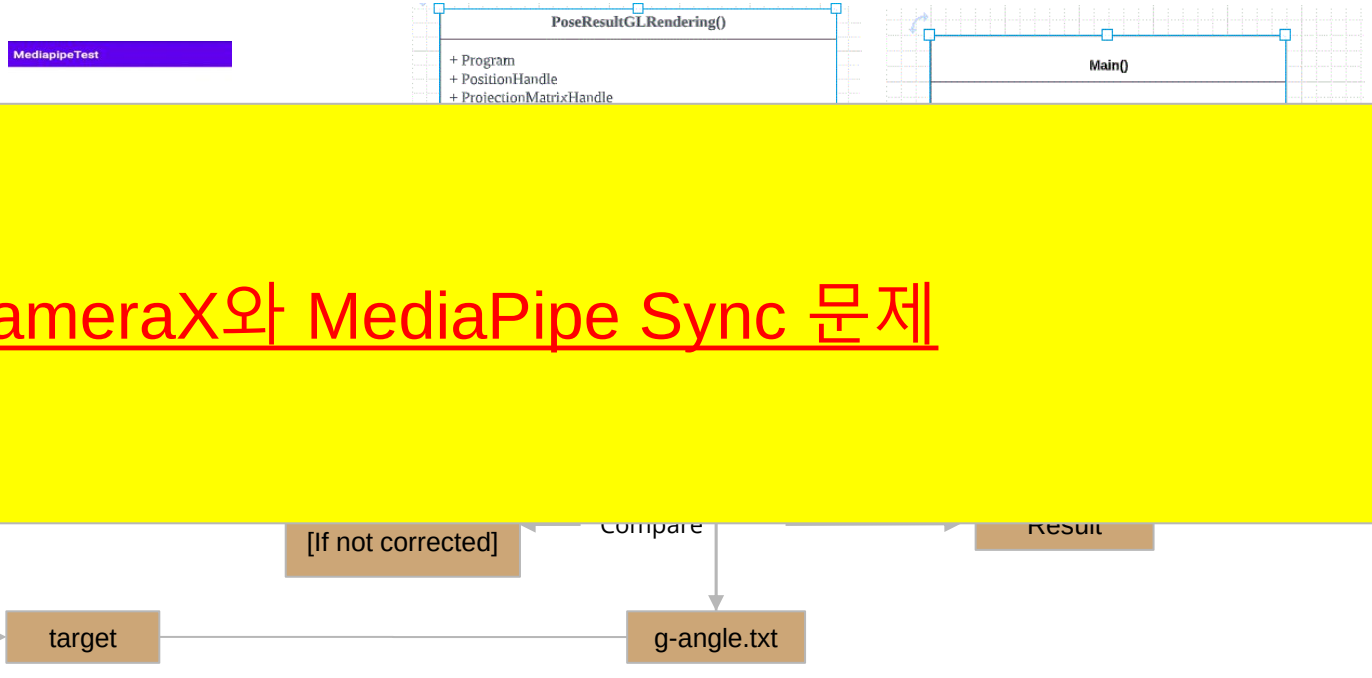
Camera Input 값으로 MediaPipe을 modeling을 하여 GLSurface View로 Landmark 구현 method

GLES Rendering 해주는 set up과 Landmark 해주는 것

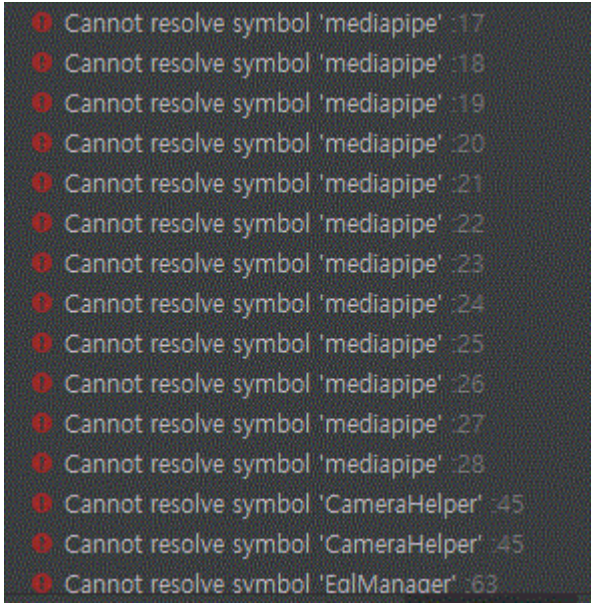



- Check_Pesrson_InsideFrame: user가 Frame 틀 안에 있는지 확인
- Load_CameraSurfaceView_User_Motion: PoseResultGLRendering 구현되어진 surfaceview 호출
- Load_GroudTruth_YoutbeClip: Groud_truth 설정으로 되어진 Youtue Clip 동영상 load
- Compare_bewteen_clipandMotion: 두 동영상의 angle value을 비교
- Evalution_movement: 비교된 pred 값들을 토대로 result 값 return

# Application Architecture



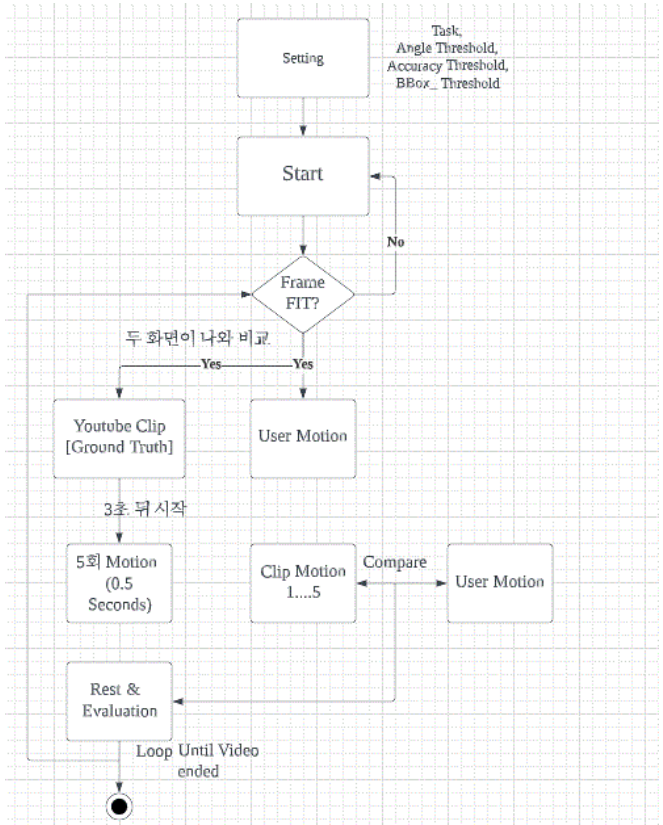
# CameraX와 MediaPipe sync 문제

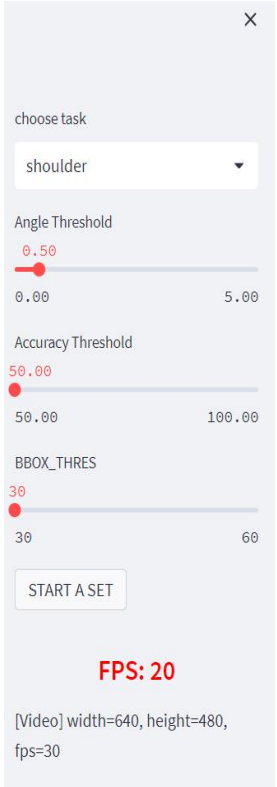



Build successful을 하였음에도 sync error 가 나옴.

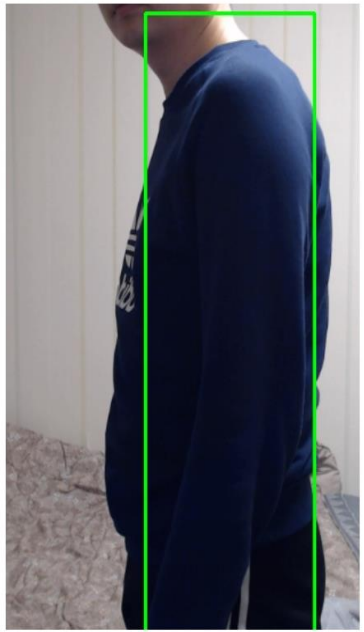
Sync Issue 확인하고 다시 설정 후 진행 test가 필요함

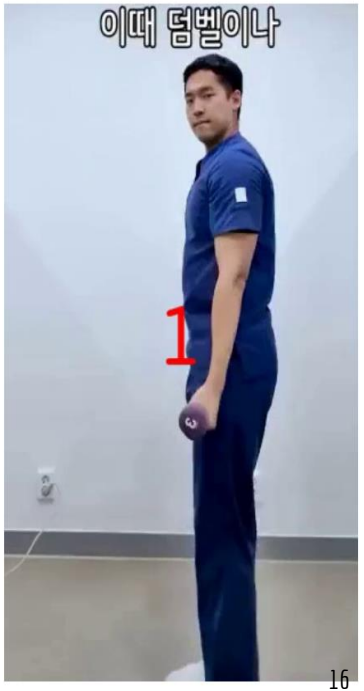
# Web Architecture




Frame 안에 User가 들어오면
마스킹이 빨간색-> 초록색으로 변환하여
Ground Truth인 동영상이 옆에 열린다.
그 후, 3초 Count 후 진행





# Demo


choose task
shoulder
Inference frequency(IF)
5
1
15
Angle Threshold
3.50
1.50
10.00
Box Padding
30
15
45
Left Arm?
Do not start
START A SET
RESTART
FPS: 1
[Frame Index 100]
Angle(elbow, shoulder, hip)
match? True
Left: 26.4225 Right: 1.3757


Rehabilitation Treatment Guide System
Please, first look at the following short video, then start to train!
Arguments
Inference frequency(IF) : Inferecne with MediaPipe Model for every IF number of frame
Angle Threshold : Threshold for allowance of error angle degree between USER and TARGET
Box Padding : Number of padding pixels to start based on TARGET person bounding box
Left Arm : Check if you want to train the left arm
Do not start : If you check this box, you will always not start the training program. For Debugging.
USER
TARGET
어깨 앞에서 나타나는
Count/Frame: 9 | Match Accuracy: 0.4286

# Thank you