Handling State Warning

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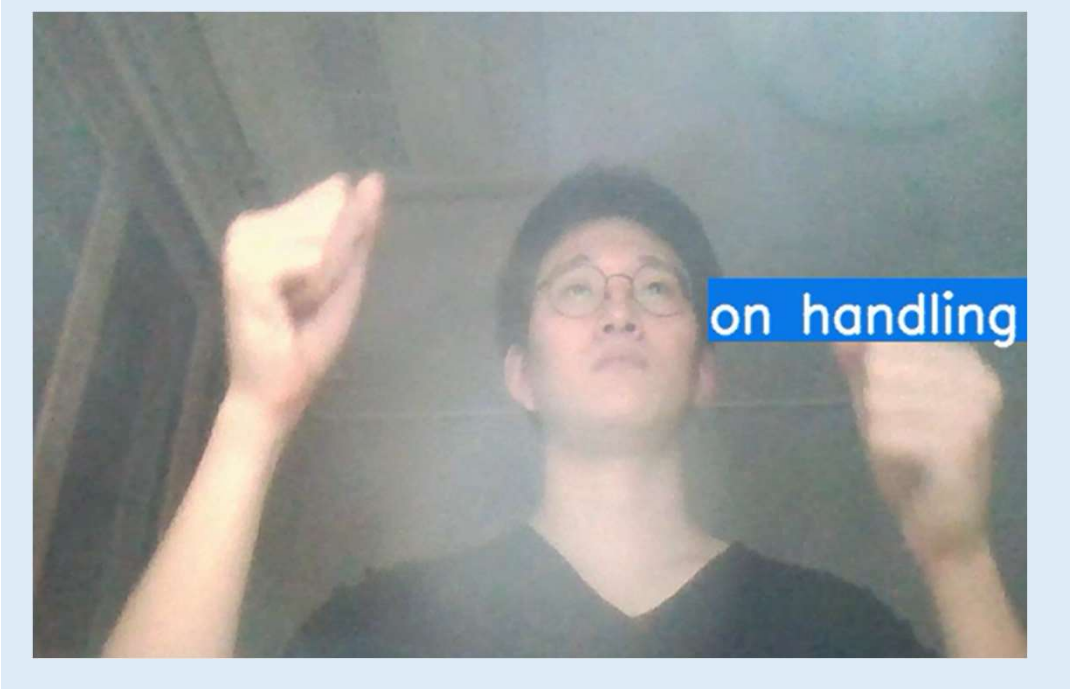
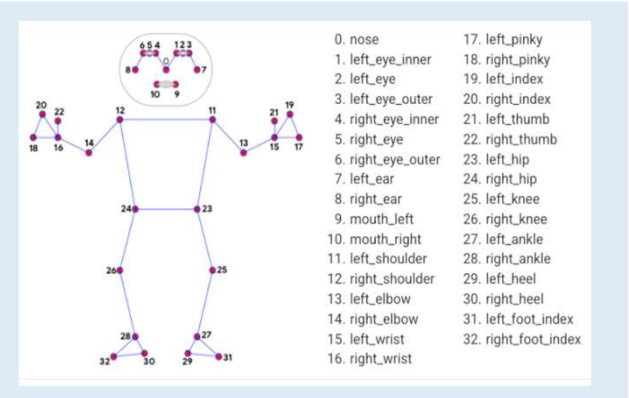
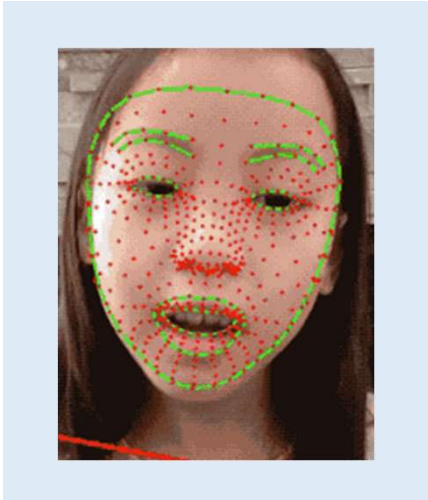
Problem

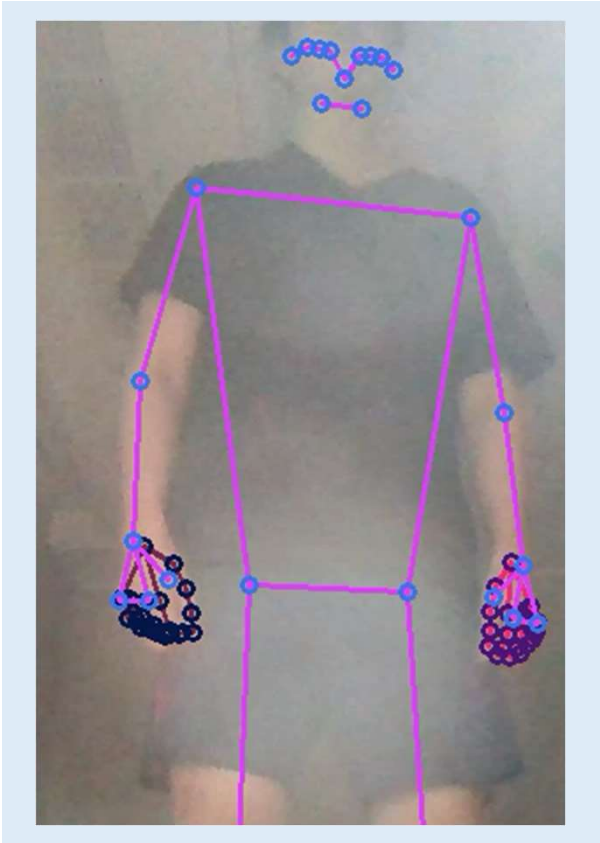
Proposal



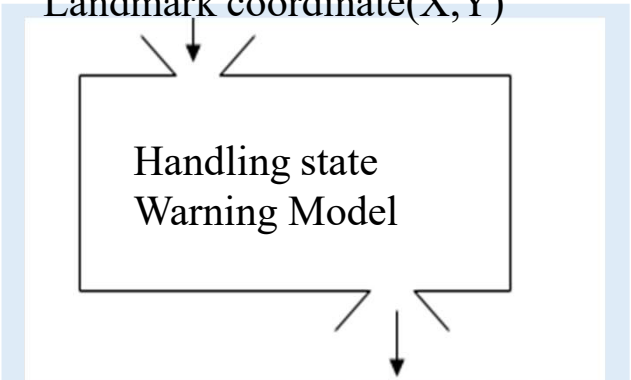
Mediapipe Solution







Landmark coordinate(X,Y)

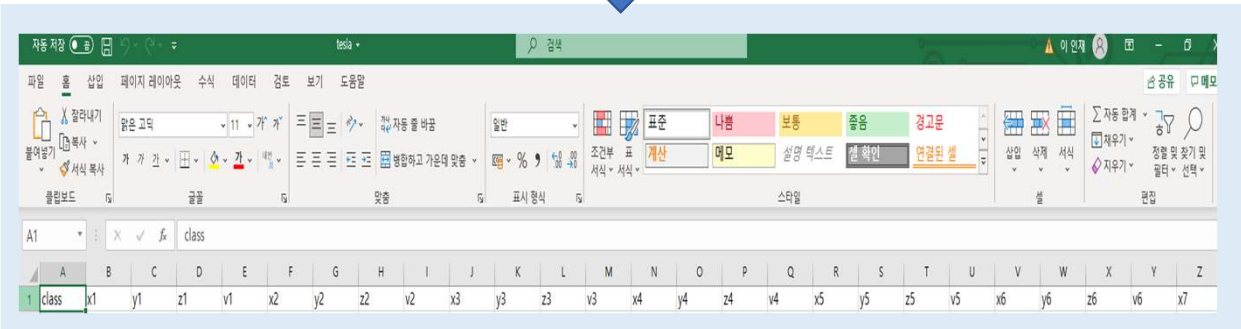


Ouput: On handling or No handling

Collecting dataset

```python
landmarks = ['class']
for val in range(1, num_coords+1):
    landmarks += ['x{}'.format(val), 'y{}'.format(val), 'z{}'.format(val), 'v{}'.format(val)]
```

```python
with open('tesla.csv', mode='w', newline='') as f: # csv 확장자파일 coords를 쓰기 형태로 연다.
    csv_writer = csv.writer(f, delimiter=',', quotechar='"', quoting=csv.QUOTE_MINIMAL)
    csv_writer.writerow(landmarks)
```



Collecting dataset(No Handling)

```python
class_name = 'on handling'
```

```python
cap = cv2.VideoCapture(0)
# Initiate holistic model
with mp_holistic.Holistic(min_detection_confidence=0.5, min_tracking_confidence=0.5) as holistic:

    while cap.isOpened():
        ret, frame = cap.read()

        # Recolor Feed
        image = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
        image.flags.writeable = False

        # Make Detections
        results = holistic.process(image)
        # print(results.face_landmarks)

        # face_landmarks, pose_landmarks, left_hand_landmarks, right_hand_landmarks

        # Recolor image back to BGR for rendering
        image.flags.writeable = True
        image = cv2.cvtColor(image, cv2.COLOR_RGB2BGR)

        # 1. Draw face landmarks
        mp_drawing.draw_landmarks(image, results.face_landmarks, mp_holistic.FACE_CONNECTIONS,
                                  mp_drawing.DrawingSpec(color=(80,110,10), thickness=1, circle_radius=1),
                                  mp_drawing.DrawingSpec(color=(80,256,121), thickness=1, circle_radius=1)
                                  )

        # 2. Right hand
        mp_drawing.draw_landmarks(image, results.right_hand_landmarks, mp_holistic.HAND_CONNECTIONS,
                                  mp_drawing.DrawingSpec(color=(80,22,10), thickness=2, circle_radius=4),
                                  mp_drawing.DrawingSpec(color=(80,44,121), thickness=2, circle_radius=2)
                                  )

        # 3. Left Hand
        mp_drawing.draw_landmarks(image, results.left_hand_landmarks, mp_holistic.HAND_CONNECTIONS,
                                  mp_drawing.DrawingSpec(color=(121,22,76), thickness=2, circle_radius=4),
                                  mp_drawing.DrawingSpec(color=(121,44,250), thickness=2, circle_radius=2)
                                  )

        # 4. Pose Detections
        mp_drawing.draw_landmarks(image, results.pose_landmarks, mp_holistic.POSE_CONNECTIONS,
                                  mp_drawing.DrawingSpec(color=(245,117,66), thickness=2, circle_radius=4),
                                  mp_drawing.DrawingSpec(color=(245,66,230), thickness=2, circle_radius=2)
                                  )

        # Export coordinates
        try:
            # pose landmark를 추출 후 numpy array 형태로 변환하였다. 이 때 flatten을 사용해 1차원으로 만들어준다.
            pose = results.pose_landmarks.landmark
            pose_row = list(np.array([[landmark.x, landmark.y, landmark.z, landmark.visibility] for landmark in pose]).flatten())

            # Extract face landmarks
            face = results.face_landmarks.landmark
            face_row = list(np.array([[landmark.x, landmark.y, landmark.z, landmark.visibility] for landmark in face]).flatten())

            # pose 결과 face 결과 결합하여 하나로 만들어준다.
            row = pose_row+face_row

            # 마지막에 결과값인 class name을 입력하였다.
            row.insert(0, class_name)

            # Export to CSV
            with open('test.csv', mode='a', newline='') as f:# 이미 만들어진 csv파일에 새로운 데이터를 입력하는 형태로 코드이다.
                csv_writer = csv.writer(f, delimiter=',', quotechar='"', quoting=csv.QUOTE_MINIMAL)
                csv_writer.writerow(row)

        except:
            pass

        cv2.imshow('Raw Webcam Feed', image)

        if cv2.waitKey(10) & 0xFF == ord('q'):
            break

cap.release()
cv2.destroyAllWindows()
```

Collecting dataset(On Handling)

```python
class_name = 'On Handling'

cap = cv2.VideoCapture(0)
# Initiate holistic model
with mp_holistic.Holistic(min_detection_confidence=0.5, min_tracking_confidence=0.5) as holistic:

    while cap.isOpened():
        ret, frame = cap.read()

        # Recolor Feed
        image = cv2.cvtColor(frame, cv2.COLOR_BGR2RGB)
        image.flags.writeable = False

        # Make Detections
        results = holistic.process(image)
        # print(results.face_landmarks)

        # face_landmarks, pose_landmarks, left_hand_landmarks, right_hand_landmarks

        # Recolor image back to BGR for rendering
        image.flags.writeable = True
        image = cv2.cvtColor(image, cv2.COLOR_RGB2BGR)

        # 1. Draw face landmarks
        mp_drawing.draw_landmarks(image, results.face_landmarks, mp_holistic.FACE_CONNECTIONS,
                                  mp_drawing.DrawingSpec(color=(80,110,10), thickness=1, circle_radius=1),
                                  mp_drawing.DrawingSpec(color=(80,256,121), thickness=1, circle_radius=1)
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                                  mp_drawing.DrawingSpec(color=(80,22,10), thickness=2, circle_radius=4),
                                  mp_drawing.DrawingSpec(color=(80,44,121), thickness=2, circle_radius=2)
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                                  mp_drawing.DrawingSpec(color=(121,22,76), thickness=2, circle_radius=4),
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                                  )

        # 4. Pose Detections
        mp_drawing.draw_landmarks(image, results.pose_landmarks, mp_holistic.POSE_CONNECTIONS,
                                  mp_drawing.DrawingSpec(color=(245,117,66), thickness=2, circle_radius=4),
                                  mp_drawing.DrawingSpec(color=(245,66,230), thickness=2, circle_radius=2)
                                  )

        # Export coordinates
        try:
            # pose landmark를 추출 후 numpy array 형태로 변환한다. 이 때 flatten을 사용해 1차원으로 만들어준다.
            pose = results.pose_landmarks.landmark
            pose_row = list(np.array([[landmark.x, landmark.y, landmark.z, landmark.visibility] for landmark in pose]).flatten())

            # Extract face landmarks
            face = results.face_landmarks.landmark
            face_row = list(np.array([[landmark.x, landmark.y, landmark.z, landmark.visibility] for landmark in face]).flatten())

            # pose 결과 face 결과 결합하여 하나로 만든다.
            row = pose_row+face_row

            # 추가로서 결과에 class name을 입력하준다.
            row.insert(0, class_name)

            # Export to CSV
            with open('test.csv', mode='a', newline='') as f:# 이미 만들어진 csv파일에 새로운 데이터를 입력하는 형태로 코드이다.
                csv_writer = csv.writer(f, delimiter=',', quotechar='"', quoting=csv.QUOTE_MINIMAL)
                csv_writer.writerow(row)

        except:
            pass

        cv2.imshow('Raw Webcam Feed', image)

        if cv2.waitKey(10) & 0xFF == ord('q'):
            break

cap.release()
cv2.destroyAllWindows()
```

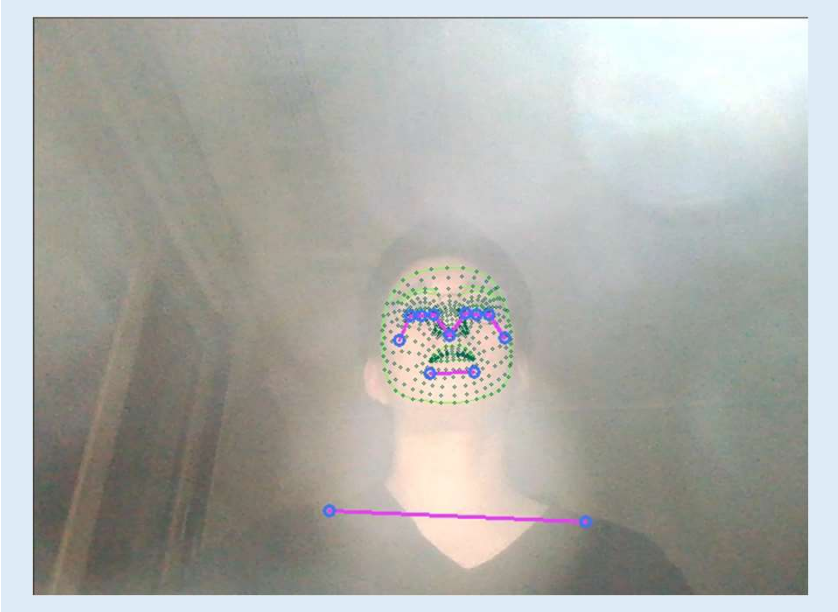

Collecting dataset

Dataset in CSV files

215	no handli	0.595236	0.576571	-0.93765	1	0.618763	0.536841	-0.85181	1	0.635369	0.53954	-0.85182	0.99996	0.652407	0.542128	-0.85201	1	0.569141	0.532694	-0.85725	1	0.551423	0.532158	-0.85777	0.999966	0.53347
216	no handli	0.58438	0.573156	-0.93565	1	0.60835	0.532458	-0.84604	1	0.625217	0.534966	-0.84608	0.999976	0.642504	0.53732	-0.8463	1	0.558337	0.529472	-0.85306	1	0.540731	0.529387	-0.85355	0.999974	0.52292
217	no handli	0.574261	0.572546	-0.92309	1	0.600984	0.530829	-0.8387	1	0.617996	0.533453	-0.83888	0.999944	0.635432	0.535919	-0.83927	1	0.551778	0.527324	-0.84683	1	0.534588	0.526897	-0.84731	0.999927	0.51717
218	no handli	0.563843	0.574177	-0.74441	1	0.590342	0.532708	-0.67104	1	0.607803	0.53499	-0.67118	0.999977	0.625651	0.537012	-0.67149	1	0.540712	0.529619	-0.66765	1	0.523671	0.529191	-0.66811	0.999959	0.50646
219	no handli	0.570083	0.572127	-0.8168	1	0.592938	0.530205	-0.734	1	0.609353	0.532127	-0.73411	0.999992	0.626171	0.533803	-0.73436	1	0.544564	0.528447	-0.73875	1	0.527514	0.528557	-0.73919	0.999987	0.5102
220	no handli	0.569993	0.570542	-0.7804	1	0.592165	0.528869	-0.696	1	0.60848	0.530522	-0.69617	0.999994	0.625188	0.531925	-0.69646	1	0.543756	0.527923	-0.70217	1	0.526701	0.528299	-0.70259	0.999989	0.50948
221	no handli	0.572754	0.568344	-0.76409	1	0.594994	0.526259	-0.68082	1	0.611422	0.527803	-0.68095	0.999993	0.62824	0.529105	-0.68114	1	0.546112	0.52574	-0.68608	1	0.528865	0.526358	-0.68649	0.999987	0.51145
222	no handli	0.573712	0.567348	-0.72917	1	0.595733	0.525359	-0.64505	1	0.612242	0.526975	-0.64517	0.999991	0.629137	0.528361	-0.64533	1	0.546621	0.524719	-0.65197	1	0.529281	0.525338	-0.65236	0.999984	0.51178
223	no handli	0.573783	0.565885	-0.657	1	0.596686	0.523799	-0.57738	1	0.613302	0.525561	-0.5775	0.999988	0.630313	0.527099	-0.5777	1	0.547515	0.522866	-0.5852	1	0.53018	0.523478	-0.58566	0.999981	0.51267
224	no handli	0.577269	0.565328	-0.68016	1	0.598697	0.522609	-0.59999	1	0.615084	0.524496	-0.60012	0.999981	0.631851	0.526153	-0.60035	1	0.549486	0.521313	-0.60753	1	0.531829	0.521808	-0.60799	0.99997	0.51403
225	no handli	0.577788	0.565799	-0.73208	1	0.598793	0.523236	-0.64678	1	0.615187	0.525129	-0.64687	0.999995	0.63196	0.526793	-0.64701	1	0.549571	0.521981	-0.65618	1	0.532021	0.522518	-0.65664	0.999991	0.51431
226	no handli	0.582799	0.561642	-0.873	1	0.60252	0.520399	-0.7766	1	0.618848	0.522375	-0.77667	0.999983	0.635556	0.524134	-0.77678	1	0.552584	0.519146	-0.78888	1	0.534691	0.519788	-0.78928	0.999973	0.51664
227	no handli	0.583142	0.55484	-0.73526	1	0.602776	0.514548	-0.64845	1	0.619229	0.516874	-0.64853	0.999977	0.636036	0.518976	-0.64873	1	0.552589	0.512581	-0.66273	1	0.534721	0.513044	-0.66321	0.999967	0.51670
228	no handli	0.586015	0.55462	-0.87288	1	0.603401	0.514242	-0.78427	1	0.619389	0.516432	-0.78432	0.999953	0.636145	0.518426	-0.78447	1	0.554296	0.512378	-0.80129	1	0.536515	0.512829	-0.80165	0.999938	0.51857
229	on handli	0.565637	0.629227	-0.21332	1	0.583925	0.599419	-0.13704	1	0.59735	0.601554	-0.13691	1	0.611019	0.603371	-0.13655	1	0.543591	0.59893	-0.1529	1	0.529386	0.599747	-0.15331	1	0.51521
230	on handli	0.566504	0.627656	-0.14485	1	0.587023	0.601657	-0.06727	1	0.600617	0.604934	-0.06726	1	0.614473	0.607847	-0.06713	1	0.546451	0.598178	-0.07784	1	0.532408	0.598184	-0.07827	1	0.51839

Train

```
# 수집한 dataset을 train dataset과 test set를 7:3으로 random하게 나눈다.
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=1234)
```

Split dataset

```
#make_pipeline(머신러닝 모델에 사용할 파이프라인 구축하는 모듈),StandardScaler(datsset을 표준화 하는 모듈) import
from sklearn.pipeline import make_pipeline
from sklearn.preprocessing import StandardScaler

from sklearn.linear_model import LogisticRegression, RidgeClassifier
from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier
```

```
#위에서 정의한 pipeline에 사용할 모델들 구축(좋은 결과를 내기 위해 여러가지 모델 사용)
pipelines = {
    'lr':make_pipeline(StandardScaler(), LogisticRegression()),
    'rc':make_pipeline(StandardScaler(), RidgeClassifier()),
    'rf':make_pipeline(StandardScaler(), RandomForestClassifier()),
    'gb':make_pipeline(StandardScaler(), GradientBoostingClassifier()),
}
```

```
list(pipelines.values())[0] #처음 data가 표준화 된 후 logisticregression 모델을 사용해서 학습한다.
```

```
Pipeline(steps=[('standardscaler', StandardScaler()),
                ('logisticregression', LogisticRegression())])
```

```
fit_models = {}
#파이프 라인들 안의 모델들을 이용해서 학습한다.
for algo, pipeline in pipelines.items():
    model = pipeline.fit(X_train, y_train)
    fit_models[algo] = model
```

Train model

```
fit_models
```

```
{'lr': Pipeline(steps=[('standardscaler', StandardScaler()),
                       ('logisticregression', LogisticRegression())]),
 'rc': Pipeline(steps=[('standardscaler', StandardScaler()),
                       ('ridgeclassifier', RidgeClassifier())]),
 'rf': Pipeline(steps=[('standardscaler', StandardScaler()),
                       ('randomforestclassifier', RandomForestClassifier())]),
 'gb': Pipeline(steps=[('standardscaler', StandardScaler()),
                       ('gradientboostingclassifier', GradientBoostingClassifier())])}
```

Test

```
# Make Detections
X = pd.DataFrame([row])
body_language_class = model.predict(X)[0] #landmark의 좌표값을 넣어서 운전상태를 나타내는 class를 body_language_c
body_language_prob = model.predict_proba(X)[0] # 예측한 운전상태(class) 정확도를 측정한다.
print(body_language_class, body_language_prob)

# 영상에 운전상태(class)와 class의 확률을 왼쪽 귀를 기준으로 동일한 곳에 표시하기 위해 왼쪽귀를 기준으로 잡는다.
coords = tuple(np.multiply(
                np.array(
                    (results.pose_landmarks.landmark[mp_holistic.PoseLandmark.LEFT_EAR].x,
                     results.pose_landmarks.landmark[mp_holistic.PoseLandmark.LEFT_EAR].y))
            , [640,480]).astype(int)) #웹캠 frame에 크기를 맞춰준다.

cv2.rectangle(image,
              (coords[0], coords[1]+5),
              (coords[0]+len(body_language_class)*20, coords[1]-30),
              (245, 117, 16), -1)
cv2.putText(image, body_language_class, coords,
            cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 255, 255), 2, cv2.LINE_AA)

# Get status box
cv2.rectangle(image, (0,0), (250, 60), (245, 117, 16), -1)

# Display Class
cv2.putText(image, 'CLASS'
            , (95,12), cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 0), 1, cv2.LINE_AA)
cv2.putText(image, body_language_class.split(' ')[0]
            , (90,40), cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 255, 255), 2, cv2.LINE_AA)

# Display Probability
cv2.putText(image, 'PROB'
            , (15,12), cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 0), 1, cv2.LINE_AA)
# probobility는 최댓값을 출력하도록 한다.
cv2.putText(image, str(round(body_language_prob[np.argmax(body_language_prob)],2))
            , (10,40), cv2.FONT_HERSHEY_SIMPLEX, 1, (255, 255, 255), 2, cv2.LINE_AA)
```

```
            coords = tuple(np.multiply(
                            np.array(
                                (results.pose_landmarks.landmark[mp_holistic.PoseLandma
                                 results.pose_landmarks.landmark[mp_holistic.PoseLandma
                        , [640,480]).astype(int)) #웹캠 frame에 크기를 맞춰준다.

            cv2.rectangle(image,
                          (coords[0], coords[1]+5),
                          (coords[0]+len(body_language_class)*20, coords[1]-30),
                          (245, 117, 16), -1)
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            cv2.putText(image, str(round(body_language_prob[np.argmax(body_language_prc
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        except:
            pass

        cv2.imshow('Raw Webcam Feed', image)

        if cv2.waitKey(10) & 0xFF == ord('q'):
            break

cap.release()
cv2.destroyAllWindows()
```

```
no handling [0.55 0.45]
no handling [0.64 0.36]
no handling [0.75 0.25]
no handling [0.69 0.31]
no handling [0.73 0.27]
```

Driver State Warning

```
            # 영상에 운전상태(class)와 class의 확
            coords = tuple(np.multiply(
                            np.array(
                                (results.pose_lan
                                 results.pose_lan
                        , [640,480]).astype(int))

            cv2.rectangle(image,
                          (coords[0], coords[1]+5
                          (coords[0]+len(body_lan
                          (245, 117, 16), -1)
            cv2.putText(image, body_language_class
                        cv2.FONT_HERSHEY_SIMPLEX,

            # Get status box
            cv2.rectangle(image, (0,0), (250, 60),

            # Display Class
            cv2.putText(image, 'CLASS'
                        , (95,12), cv2.FONT_HERSHE
            cv2.putText(image, body_language_class
                        , (90,40), cv2.FONT_HERSHE

            # Display Probability
            cv2.putText(image, 'PROB'
                        , (15,12), cv2.FONT_HERSHE
            # probability는 최댓값을 출력하도록 한
            cv2.putText(image, str(round(body_lan
                        , (10,40), cv2.FONT_HERSHE

        except:
            pass

        cv2.imshow('Raw Webcam Feed', image)

        if cv2.waitKey(10) & 0xFF == ord('q'):
            break

cap.release()
cv2.destroyAllWindows()
```

In [ ]:

Thank You!