In [ ]:

```
#!/usr/bin/env python
# coding: utf-8


import os
import cv2
cap=cv2.VideoCapture(0)
directory='D:/INTERNSHIPS/IBM_SKILLSBUILD/fromfirst/create_dataset/IMAGES/'


while True:
    _,frame=cap.read()
    count = {
             'a': len(os.listdir(directory+"/A")),
             'b': len(os.listdir(directory+"/B")),
             'c': len(os.listdir(directory+"/C")),
             'd': len(os.listdir(directory+"/D")),
             'e': len(os.listdir(directory+"/E")),
             'f': len(os.listdir(directory+"/F")),
             'g': len(os.listdir(directory+"/G")),
             'h': len(os.listdir(directory+"/H")),
             'i': len(os.listdir(directory+"/I")),
             'j': len(os.listdir(directory+"/J")),
             'k': len(os.listdir(directory+"/K")),
             'l': len(os.listdir(directory+"/L")),
             'm': len(os.listdir(directory+"/M")),
             'n': len(os.listdir(directory+"/N")),
             'o': len(os.listdir(directory+"/O")),
             'p': len(os.listdir(directory+"/P")),
             'q': len(os.listdir(directory+"/Q")),
             'r': len(os.listdir(directory+"/R")),
             's': len(os.listdir(directory+"/S")),
             't': len(os.listdir(directory+"/T")),
             'u': len(os.listdir(directory+"/U")),
             'v': len(os.listdir(directory+"/V")),
             'w': len(os.listdir(directory+"/W")),
             'x': len(os.listdir(directory+"/X")),
             'y': len(os.listdir(directory+"/Y")),
             'z': len(os.listdir(directory+"/Z"))
             }

    row = frame.shape[1]
    col = frame.shape[0]
    cv2.rectangle(frame,(0,40),(300,400),(255,255,255),2)
    cv2.imshow("data",frame)
    cv2.imshow("ROI",frame[40:400,0:300])
    frame=frame[40:400,0:300]
    interrupt = cv2.waitKey(10)
    if interrupt & 0xFF == ord('a'):
        cv2.imwrite(directory+'A/'+str(count['a'])+'.png',frame)
    if interrupt & 0xFF == ord('b'):
        cv2.imwrite(directory+'B/'+str(count['b'])+'.png',frame)
    if interrupt & 0xFF == ord('c'):
        cv2.imwrite(directory+'C/'+str(count['c'])+'.png',frame)
    if interrupt & 0xFF == ord('d'):
        cv2.imwrite(directory+'D/'+str(count['d'])+'.png',frame)
    if interrupt & 0xFF == ord('e'):
        cv2.imwrite(directory+'E/'+str(count['e'])+'.png',frame)
    if interrupt & 0xFF == ord('f'):
        cv2.imwrite(directory+'F/'+str(count['f'])+'.png',frame)
    if interrupt & 0xFF == ord('g'):
        cv2.imwrite(directory+'G/'+str(count['g'])+'.png',frame)
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    if interrupt & 0xFF == ord('h'):
        cv2.imwrite(directory+'H/'+str(count['h'])+'.png',frame)
    if interrupt & 0xFF == ord('i'):
        cv2.imwrite(directory+'I/'+str(count['i'])+'.png',frame)
    if interrupt & 0xFF == ord('j'):
        cv2.imwrite(directory+'J/'+str(count['j'])+'.png',frame)
    if interrupt & 0xFF == ord('k'):
        cv2.imwrite(directory+'K/'+str(count['k'])+'.png',frame)
    if interrupt & 0xFF == ord('l'):
        cv2.imwrite(directory+'L/'+str(count['l'])+'.png',frame)
    if interrupt & 0xFF == ord('m'):
        cv2.imwrite(directory+'M/'+str(count['m'])+'.png',frame)
    if interrupt & 0xFF == ord('n'):
        cv2.imwrite(directory+'N/'+str(count['n'])+'.png',frame)
    if interrupt & 0xFF == ord('o'):
        cv2.imwrite(directory+'O/'+str(count['o'])+'.png',frame)
    if interrupt & 0xFF == ord('p'):
        cv2.imwrite(directory+'P/'+str(count['p'])+'.png',frame)
    if interrupt & 0xFF == ord('q'):
        cv2.imwrite(directory+'Q/'+str(count['q'])+'.png',frame)
    if interrupt & 0xFF == ord('r'):
        cv2.imwrite(directory+'R/'+str(count['r'])+'.png',frame)
    if interrupt & 0xFF == ord('s'):
        cv2.imwrite(directory+'S/'+str(count['s'])+'.png',frame)
    if interrupt & 0xFF == ord('t'):
        cv2.imwrite(directory+'T/'+str(count['t'])+'.png',frame)
    if interrupt & 0xFF == ord('u'):
        cv2.imwrite(directory+'U/'+str(count['u'])+'.png',frame)
    if interrupt & 0xFF == ord('v'):
        cv2.imwrite(directory+'V/'+str(count['v'])+'.png',frame)
    if interrupt & 0xFF == ord('w'):
        cv2.imwrite(directory+'W/'+str(count['w'])+'.png',frame)
    if interrupt & 0xFF == ord('x'):
        cv2.imwrite(directory+'X/'+str(count['x'])+'.png',frame)
    if interrupt & 0xFF == ord('y'):
        cv2.imwrite(directory+'Y/'+str(count['y'])+'.png',frame)
    if interrupt & 0xFF == ord('z'):
        cv2.imwrite(directory+'Z/'+str(count['z'])+'.png',frame)


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

In [ ]:

```
import cv2
import numpy as np
import os
import mediapipe as mp

mp_drawing = mp.solutions.drawing_utils
mp_drawing_styles = mp.solutions.drawing_styles
mp_hands = mp.solutions.hands

def mediapipe_detection(image, model):
    image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
    image.flags.writeable = False
    results = model.process(image)
    image.flags.writeable = True
    image = cv2.cvtColor(image, cv2.COLOR_RGB2BGR)
    return image, results

def draw_styled_landmarks(image, results):
    if results.multi_hand_landmarks:
      for hand_landmarks in results.multi_hand_landmarks:
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        mp_drawing.draw_landmarks(
            image,
            hand_landmarks,
            mp_hands.HAND_CONNECTIONS,
            mp_drawing_styles.get_default_hand_landmarks_style(),
            mp_drawing_styles.get_default_hand_connections_style())


def extract_keypoints(results):
    if results.multi_hand_landmarks:
      for hand_landmarks in results.multi_hand_landmarks:
        rh = np.array([[res.x, res.y, res.z] for res in hand_landmarks.landmark]).
        return(np.concatenate([rh]))
# Path for exported data, numpy arrays
DATA_PATH = os.path.join('MP_Data')

actions = np.array(['A','B','C','D','E','F','G','H','I','J','K','L','M','N','O','P

no_sequences = 30

sequence_length = 30
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In [ ]:

```
from data_preprocessing import *
from time import sleep

for action in actions:
    for sequence in range(no_sequences):
        try:
            os.makedirs(os.path.join(DATA_PATH, action, str(sequence)))
        except:
            pass

with mp_hands.Hands(
    model_complexity=0,
    min_detection_confidence=0.5,
    min_tracking_confidence=0.5) as hands:

    for action in actions:
        for sequence in range(no_sequences):
            for frame_num in range(sequence_length):
                frame=cv2.imread('IMAGES/{}/{}.png'.format(action,sequence))
                image, results = mediapipe_detection(frame, hands)
                draw_styled_landmarks(image, results)

                if frame_num == 0:
                    cv2.putText(image, 'STARTING COLLECTION', (120,200),
                               cv2.FONT_HERSHEY_SIMPLEX, 1, (0,255, 0), 4, cv2.LINE
                    cv2.putText(image, 'Collecting frames for {} Video Number {}'.
                               cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 255), 1, cv2.L

                    cv2.imshow('OpenCV Feed', image)
                    cv2.waitKey(200)
                else:
                    cv2.putText(image, 'Collecting frames for {} Video Number {}'.
                               cv2.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 255), 1, cv2.L

                    cv2.imshow('OpenCV Feed', image)


                keypoints = extract_keypoints(results)
                npy_path = os.path.join(DATA_PATH, action, str(sequence), str(frame
                np.save(npy_path, keypoints)
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                if cv2.waitKey(10) & 0xFF == ord('q'):
                    break

    cv2.destroyAllWindows()
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In [ ]:
```
from data_preprocessing import *
from sklearn.model_selection import train_test_split
from keras.utils import to_categorical
from keras.models import Sequential
from keras.layers import LSTM, Dense
from keras.callbacks import TensorBoard
label_map = {label:num for num, label in enumerate(actions)}
print(label_map)
sequences, labels = [], []
for action in actions:
    for sequence in range(no_sequences):
        window = []
        for frame_num in range(sequence_length):
            res = np.load(os.path.join(DATA_PATH, action, str(sequence), "{}.npy".
            window.append(res)
        sequences.append(window)
        labels.append(label_map[action])

X = np.array(sequences)
y = to_categorical(labels).astype(int)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.05)

log_dir = os.path.join('Logs')
tb_callback = TensorBoard(log_dir=log_dir)
model = Sequential()
model.add(LSTM(64, return_sequences=True, activation='relu', input_shape=(30,63)))
model.add(LSTM(128, return_sequences=True, activation='relu'))
model.add(LSTM(64, return_sequences=False, activation='relu'))
model.add(Dense(64, activation='relu'))
model.add(Dense(32, activation='relu'))
model.add(Dense(actions.shape[0], activation='softmax'))
res = [.7, 0.2, 0.1]

model.compile(optimizer='Adam', loss='categorical_crossentropy', metrics=['categor
model.fit(X_train, y_train, epochs=200, callbacks=[tb_callback])
model.summary()

model_json = model.to_json()
with open("model.json", "w") as json_file:
    json_file.write(model_json)
model.save('model.h5')
```

In [ ]:
```
from data_preprocessing import *
from keras.utils import to_categorical
from keras.models import model_from_json
from keras.layers import LSTM, Dense
from keras.callbacks import TensorBoard
json_file = open("model.json", "r")
model_json = json_file.read()
json_file.close()
model = model_from_json(model_json)
model.load_weights("model.h5")

colors = []
for i in range(0,20):
    colors.append((245,117,16))
print(len(colors))
def prob_viz(res, actions, input_frame, colors,threshold):
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    output_frame = input_frame.copy()
    for num, prob in enumerate(res):
        cv2.rectangle(output_frame, (0,60+num*40), (int(prob*100), 90+num*40), colo
        cv2.putText(output_frame, actions[num], (0, 85+num*40), cv2.FONT_HERSHEY_SI

    return output_frame


# New detection variables
sequence = []
sentence = []
accuracy=[]
predictions = []
threshold = 0.8

cap = cv2.VideoCapture(0)
with mp_hands.Hands(
    model_complexity=0,
    min_detection_confidence=0.5,
    min_tracking_confidence=0.5) as hands:
    while cap.isOpened():

        ret, frame = cap.read()
        cropframe=frame[40:400,0:300]
        frame=cv2.rectangle(frame,(0,40),(300,400),(0,255,0),2)
        image, results = mediapipe_detection(cropframe, hands)

# Prediction logic
        keypoints = extract_keypoints(results)
        sequence.append(keypoints)
        sequence = sequence[-30:]

        try:
            if len(sequence) == 30:
                res = model.predict(np.expand_dims(sequence, axis=0))[0]
                print(actions[np.argmax(res)])
                predictions.append(np.argmax(res))

                if np.unique(predictions[-10:])[0]==np.argmax(res):
                    if res[np.argmax(res)] > threshold:
                        if len(sentence) > 0:
                            if actions[np.argmax(res)] != sentence[-1]:
                                sentence.append(actions[np.argmax(res)])
                                accuracy.append(str(res[np.argmax(res)]*100))
                        else:
                            sentence.append(actions[np.argmax(res)])
                            accuracy.append(str(res[np.argmax(res)]*100))

                if len(sentence) > 1:
                    sentence = sentence[-1:]
                    accuracy=accuracy[-1:]

        except Exception as e:
            pass

        cv2.rectangle(frame, (0,0), (300, 40), (0, 0, 255), -1)
        cv2.putText(frame,"Output: -"+' '.join(sentence)+''.join(accuracy), (3,30),
                    cv2.FONT_HERSHEY_SIMPLEX, 1, (0, 0, 0), 2, cv2.LINE_AA)

        cv2.imshow('OpenCV Feed', frame)

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

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

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