BODY POSTURE RECOGNITION SYSTEM

END TERM REPORT

By

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Student Declaration

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<u>BONAFIDE CERTIFICATE</u>

Certified that this project report **"BODY POSTURE RECOGNITION SYSTEM"** is the bonafide work of **"SUDERSHAN, ANAND KUSHAL , BHUVAN,PANKAJ**", who carried out the project work under my supervision.

<u>Signature of the Supervisor</u>
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1.1Human recognition using smartphones data set:

The experiments have been carried out with a group of 30 volunteers with in a age bracket of 19-48 years. Each person performed six activities (WALKING, WALKING_UPSTAIRS, WALKING_DOWNSTAIRS, SITTING, STANDING, LAYING) wearing a smart phone on the waist using its embedded accelerometer and gyroscope, we captured 3-axial linear acceleration and 3- axial angular velocity at a constant rate of 50Hz. The experiment have been video recorded label the data manually. The obtained data set have been randomly partitioned into two sets, where 70% of volunteers were selected for generating the training data and 30% the test data

The sensor signals(accelerometer and gyroscope) were preprocessed by applying noise filters and then sampled in fixed-width sliding windows of 2.56 sec and 50% overlap(128 readings/window). The sensor accleration signal which has gravitational and body motion components, was seperated using a butterworth low pass filter tnto body accleration and gravity. The gravitaional force is assumed to have only low frequency components therefore a filter with 0.3 Hz cutoff frequency was used. For each window a vector of Features was obtained by calculating variables from the time and frequency domain

1.2 OVERVIEW OF THE EXISTING TECHNIQUES

Establishing the identity of an individual is of paramount importance in our highly networked society. The overarchingtask of any identity management system is the ability to determine or validate the identity of its users prior to grantingthem access to the resources protected by the system. Traditionally, passwords (knowledge-based schemes) and IDcards (token-based schemes) have been used to validate the identity of an individual intending to access the services offered by an application (e.g., online banking) or a facility (e.g., theme parks). However, such mechanisms for userauthentication have several limitations. For example, passwords can be divulged to unauthorized users resulting ina breach of security; moreover, simple passwords can be easily guessed by an intruder while complex passwords canbe difficult to recollect for a legitimate user. ID cards, on the other hand, can be misplaced, forged or stolen therebyundermining the security afforded by the system. Thus, it is necessary to utilize alternate methods of authentication that are not merely based on what you know or what you have but, rather, on who you are.
Biometrics is the science of establishing the identity of an individual based on the inherent physical or behavioraltraits associated with the person. Biometric systems utilize fingerprints, iris, face, hand geometry, palmprint,finger vein structure, gait, voice, signature, keyboard typing pattern, etc. in order to recognize a person (Figure 1).
A typical biometric system operates by capturing the biometric trait of a person via an appropriately designedacquisition module and comparing the recorded trait with the biometric samples (or templates) in a database in order to determine the identity of the person (identification) or to validate a claimed identity (verification). For example, a face biometric system captures the face image of an individual, extracts a feature set from the segmented face, compares this feature set against the templates stored in the database and renders a decision regarding the identity of the individual. Thus, a generic biometric system may be viewed as a pattern recognition system in which the raw biometric data (or signal) constitutes the input pattern that is assigned a class label. In an identification system, the class label pertains to the identity of the individual while in a verification system the class label is a match (genuine) or a non-match (impostor). In both modes of operation, a reject label is emitted when the system is unable to determine a valid class.

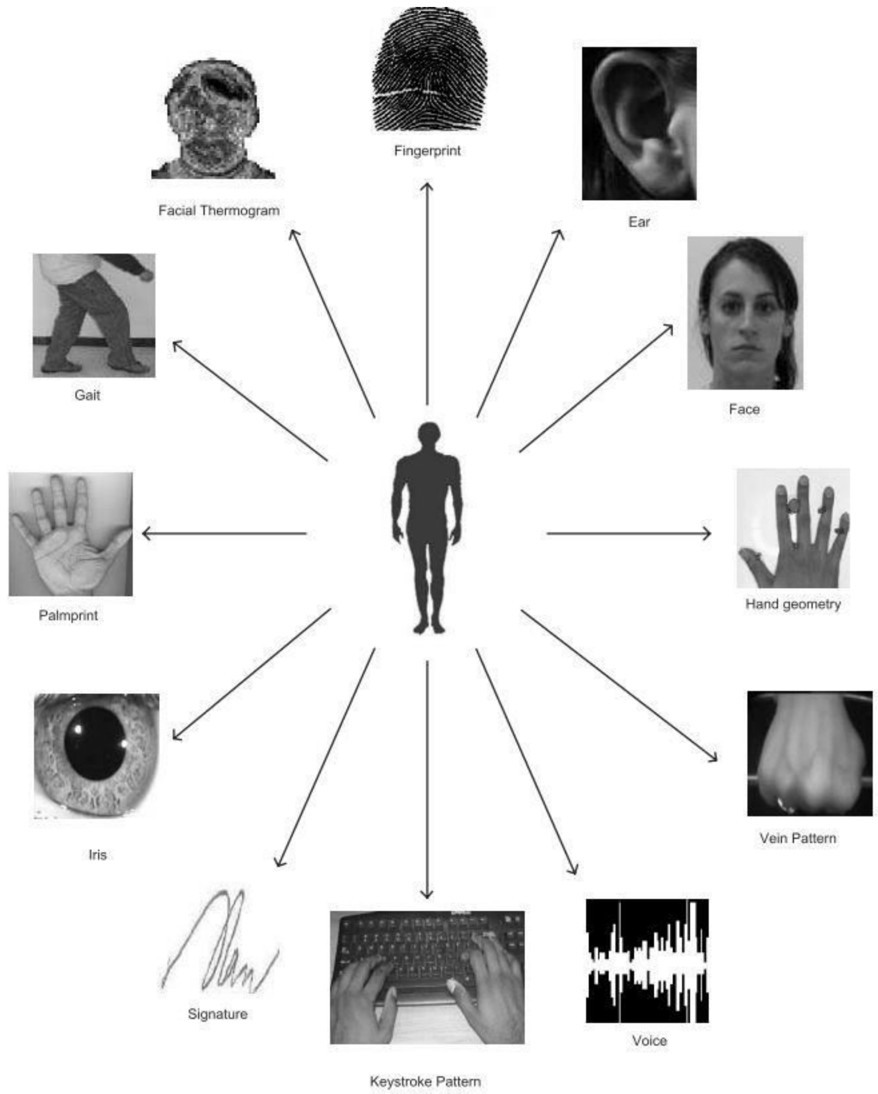


Fig. 1. Examples of biometric traits that can be used for authenticating an individual's identity.

2.0 Biometric characteristics :

A number of biometric characteristics are being used in various applications. Each biometric has its pros and cons and, therefore, the choice of a biometric trait for a particular application depends on a variety of issues besides its matching performance. Jain et al, have identified seven factors that determine the suitability of a physical or a behavioral trait to be used in a biometric application.

2.1. Universality: Every individual accessing the application should possess the trait.

2.2. Uniqueness: The given trait should be sufficiently different across individuals comprising the population.

2.3. Permanence: The biometric trait of an individual should be sufficiently invariant over a period of time with respect to the matching algorithm. A trait that changes significantly over time is not a useful biometric.

2.4. Measurability: It should be possible to acquire and digitize the biometric trait using suitable devices that do not cause undue inconvenience to the individual. Furthermore, the acquired raw data should be amenable to processing in order to extract representative feature sets.

2.5. Performance: The recognition accuracy and the resources required to achieve that accuracy should meet the constraints imposed by the application.

2.6. Acceptability: Individuals in the target population that will utilize the application should be willing to present their biometric trait to the system.

2.7. Circumvention: This refers to the ease with which the trait of an individual can be imitated using artifacts (e.g., fake fingers), in the case of physical traits, and mimicry, in the case of behavioral traits.

3. MODES OF HUMAN RECOGNITION

No single biometric is expected to effectively meet all the requirements (e.g., accuracy, practicality, cost) imposed by all applications (e.g., Digital Rights Management (DRM), access control, welfare distribution). In other words, no biometric is ideal but a number of them are admissible. The relevance of a specific biometric to an application is established depending upon the nature and requirements of the application, and the properties of the biometric characteristic. A brief introduction to some of the commonly used biometric characteristics is given below:

3.1. Face: Face recognition is a non-intrusive method, and facial attributes are probably the most common biometric features used by humans to recognize one another. The applications of facial recognition range from a static, controlled "mug-shot" authentication to a dynamic, uncontrolled face identification in a cluttered background. The most popular approaches to face recognition are based on either (i) the location and shape of facial attributes, such as the eyes, eyebrows, nose, lips, and chin and their spatial relationships, or (ii) the overall (global) analysis of the face image that represents a face as a weighted combination of a number of canonical faces. While the authentication performance of the face recognition systems that are commercially available is
Reasonable , they impose a number of restrictions on how the facial images are obtained, often requiring a fixed and simple background with controlled illumination. These systems also have difficulty in matching face images captured from two different views, under different illumination conditions, and at different times. It is questionable whether the face itself, without any contextual information, is a sufficient basis for recognizing a person from a large number of identities with an extremely high level of confidence. In order that a facial recognition system works well in practice, it should automatically (i) detect whether a face is present in the acquired image; (ii) locate the face if there is one; and (iii) recognize the face from a general viewpoint (i.e., from any pose).

3.2. Fingerprint: Humans have used fingerprints for personal identification for many decades. The matching (i.e., identification) accuracy using fingerprints has been shown to be very high. A fingerprint is the pattern of ridges and valleys on the surface of a fingertip whose formation is determined during the first seven months of fetal development. It has been empirically determined that the fingerprints of identical twins are different and so are the prints on each finger of the same person. Today, most fingerprint scanners cost less than US $50 when ordered in large quantities and the marginal cost of embedding a fingerprint-based biometric in a system (e.g., laptop computer) has become affordable in a large number of applications. The accuracy of the currently available fingerprint recognition systems is adequate for authentication systems in several applications, particularly forensics. Multiple fingerprints of a person (e.g., ten-prints used in IAFIS) provide additional information to allow for large-scale identification involving millions of identities. One problem with large-scale fingerprint recognition systems is that they require a huge amount of computational resources, especially when operating in the identification mode. Finally, fingerprints of a small fraction of the population may be unsuitable for automatic identification because of genetic factors, aging, environmental or occupational reasons (e.g., manual workers may have a large number of cuts and bruises on their fingerprints that keep changing).

3.3. Hand geometry: Hand geometry recognition systems are based on a number of measurements taken from the human hand, including its shape, size of palm, and the lengths and widths of the fingers Commercial hand geometry-based authentication systems have been installed in hundreds of locations around the world. The technique is very simple, relatively easy to use, and inexpensive. Environmental factors such as dry weather or individual anomalies such as dry skin do not appear to adversely affect the authentication accuracy of hand geometry-based systems. However, the geometry of the hand is not known to be very distinctive and hand geometry-based recognition systems cannot be scaled up for systems requiring identification of an individual from a large population.

Furthermore, hand geometry information may not be invariant during the growth period of children. In addition, an individual's jewelry (e.g., rings) or limitations in dexterity (e.g., from arthritis), may pose challenges in extracting the correct hand geometry information. The physical size of a hand geometry-based system is large, and it cannot be embedded in certain devices like laptops. There are authentication systems available that are based on measurements of only a few fingers (typically, index and middle) instead of the entire hand. These devices are smaller than those used for hand geometry, but still much larger than those used for procuring certain other traits (e.g., fingerprint, face, voice).

3.4. Palmprint: The palms of the human hands contain pattern of ridges and valleys much like the fingerprints. The area of the palm is much larger than the area of a finger and, as a result, palmprints are expected to be even more distinctive than the fingerprints. Since palmprint scanners need to capture a large area, they are bulkier and more expensive than the fingerprint sensors. Human palms also contain additional distinctive features such as principal lines and wrinkles that can be captured even with a lower resolution scanner, which would be cheaper. Finally, when using a high-resolution palmprint scanner, all the features of the hand such as geometry, ridge and valley features (e.g., minutiae and singular points such as deltas), principal lines, and wrinkles may be combined to build a highly accurate biometric system.

3.5. Iris: The iris is the annular region of the eye bounded by the pupil and the sclera (white of the eye) on either side. The visual texture of the iris is formed during fetal development and stabilizes during the first two years of life (the pigmentation, however, continues changing over an extended period of time . The complex iris texture carries very distinctive information useful for personal recognition. The accuracy and speed of currently deployed iris-based recognition systems is promising and support the feasibility of large-scale identification systems based on iris information. Each iris is distinctive and even the irises of identical twins are different. It is possible to detect contact lenses printed with a fake iris. The hippus movement of the eye may also be used as a measure of liveness for this biometric. Although early iris-based recognition systems required considerable user participation and were expensive, the newer systems have become more user-friendly and cost-effective. While iris systems have a very low False Accept Rate (FAR) compared to other biometric traits, the False Reject Rate (FRR) of these systems can be rather high.

3.6. Keystroke: It is hypothesized that each person types on a keyboard in a characteristic way. This biometric is not expected to be unique to each individual but it may be expected to offer sufficient discriminatory information to permit identity verification. Keystroke dynamics is a behavioral biometric; one may expect to observe large intra-class variations in a person's typing patterns due to changes in emotional state, position of the user with respect to the keyboard, type of keyboard used, etc. The keystrokes of a person could be monitored unobtrusively as that person is keying in information. This biometric permits "continuous verification" of an individual's identity over a session after the person logs in using a stronger biometric such as fingerprint or iris.

3.7. Signature: The way a person signs her name is known to be a characteristic of that individual. Although signatures require contact with the writing instrument and an effort on the part of the user, they have been accepted in government, legal, and commercial transactions as a method of authentication. With the proliferation of PDAs and Tablet PCs, on-line signature may emerge as the biometric of choice in these devices. Signature is a behavioral biometric that changes over a period of time and is influenced by the physical and emotional conditions of the signatories. Signatures of some people vary substantially: even successive impressions of their signature are significantly different. Further, professional forgers may be able to reproduce signatures that fool
the signature verification system.

3.8. Voice: Voice is a combination of physical and behavioral biometric characteristics. The physical features of an individual's voice are based on the shape and size of the appendages (e.g., vocal tracts, mouth, nasal cavities, and lips) that are used in the synthesis of the sound. These physical characteristics of human speech are invariant for an individual, but the behavioral aspect of the speech changes over time due to age, medical conditions (such as common cold), emotional state, etc. Voice is also not very distinctive and may not be appropriate for large-scale identification. A text-dependent voice recognition system is based on the utterance of a fixed predetermined phrase. A text-independent voice recognition system recognizes the speaker independent of what she speaks. A text-independent system is more difficult to design than a text-dependent system but offers more protection against fraud. A disadvantage of voice-based recognition is that speech features are sensitive to a number of factors such as background noise. Speaker recognition is most appropriate in telephone-based applications but the voice signal is typically degraded in quality by the communication channel.

3.9. Gait: Gait refers to the manner in which a person walks, and is one of the few biometric traits that can be used to recognize people at a distance. Therefore, this trait is very appropriate in surveillance scenarios where the identity of an individual can be surreptitiously established. Most gait recognition algorithms attempt to extract the human silhouette in order to derive the spatio-temporal attributes of a moving individual. Hence, the selection of a good model to represent the human body is pivotal to the efficient functioning of a gait recognition system. Some algorithms use the optic flow associated with a set of dynamically extracted moving points on the human body to describe the gait of an individual. Gait-based systems also offer the possibility of tracking an individual over an extended period of time. However, the gait of an individual is affected by several factors including the choice of footwear, nature of clothing, affliction of the legs, walking surface, etc.

Most biometric systems that are presently in use, typically use a single biometric trait to establish identity (i.e., they are unibiometric systems). For example, the Schiphol Privium scheme at Amsterdam's Schipol airport employs iris scan smart cards to speed up the immigration process; the Ben Gurion International Airport at Tel Aviv employs automated hand geometry-based identification kiosks to enable Israeli citizens and frequent international travelers to rapidly negotiate the passport inspection process; some financial institutions in Japan have installed palm-vein authentication systems in their ATMs to validate the identity of a customer conducting a transaction; customers phoning in to schedule product shipments through Union Pacific's railcar system are authenticated by a speaker recognition software. With the proliferation of biometric-based solutions in civilian and law enforcement applications, it is important that the vulnerabilities and limitations of these systems are clearly understood. Some of the challenges commonly encountered by biometric systems are listed below.

#CODE

```
import cv2 as cv
import numpy as np
import argparse

parser = argparse.ArgumentParser()
parser.add_argument('--input', help='Path to image or video. Skip to capture frames from camera')
parser.add_argument('--thr', default=0.2, type=float, help='Threshold value for pose parts heat map')
```

```
parser.add_argument('--width', default=368, type=int, help='Resize
input to specific width.')
parser.add_argument('--height', default=368, type=int, help='Resize
input to specific height.')

args = parser.parse_args()

BODY_PARTS = { "Nose": 0, "Neck": 1, "RShoulder": 2, "RElbow":
3, "RWrist": 4,
               "LShoulder": 5, "LElbow": 6, "LWrist": 7, "RHip": 8,
"RKnee": 9,
               "RAnkle": 10, "LHip": 11, "LKnee": 12, "LAnkle": 13,
"REye": 14,
               "LEye": 15, "REar": 16, "LEar": 17, "Background": 18 }

POSE_PAIRS = [ ["Neck", "RShoulder"], ["Neck", "LShoulder"],
["RShoulder", "RElbow"],
               ["RElbow", "RWrist"], ["LShoulder", "LElbow"],
["LElbow", "LWrist"],
               ["Neck", "RHip"], ["RHip", "RKnee"], ["RKnee",
"RAnkle"], ["Neck", "LHip"],
               ["LHip", "LKnee"], ["LKnee", "LAnkle"], ["Neck", "Nose"],
["Nose", "REye"],
               ["REye", "REar"], ["Nose", "LEye"], ["LEye", "LEar"] ]

inWidth = args.width
inHeight = args.height

net = cv.dnn.readNetFromTensorflow("graph_opt.pb")

cap = cv.VideoCapture(args.input if args.input else 0)

while cv.waitKey(1) < 0:
    hasFrame, frame = cap.read()
    if not hasFrame:
```

```
        cv.waitKey()
        break

    frameWidth = frame.shape[1]
    frameHeight = frame.shape[0]

    net.setInput(cv.dnn.blobFromImage(frame, 1.0, (inWidth,
inHeight), (127.5, 127.5, 127.5), swapRB=True, crop=False))
    out = net.forward()
    out = out[:, :19, :, :]  # MobileNet output [1, 57, -1, -1], we only
need the first 19 elements

    assert(len(BODY_PARTS) == out.shape[1])

    points = []
    for i in range(len(BODY_PARTS)):
        # Slice heatmap of corresponging body's part.
        heatMap = out[0, i, :, :]

        # Originally, we try to find all the local maximums. To simplify
a sample
        # we just find a global one. However only a single pose at the
same time
        # could be detected this way.
        _, conf, _, point = cv.minMaxLoc(heatMap)
        x = (frameWidth * point[0]) / out.shape[3]
        y = (frameHeight * point[1]) / out.shape[2]
        # Add a point if it's confidence is higher than threshold.
        points.append((int(x), int(y)) if conf > args.thr else None)

    for pair in POSE_PAIRS:
        partFrom = pair[0]
        partTo = pair[1]
        assert(partFrom in BODY_PARTS)
        assert(partTo in BODY_PARTS)
```

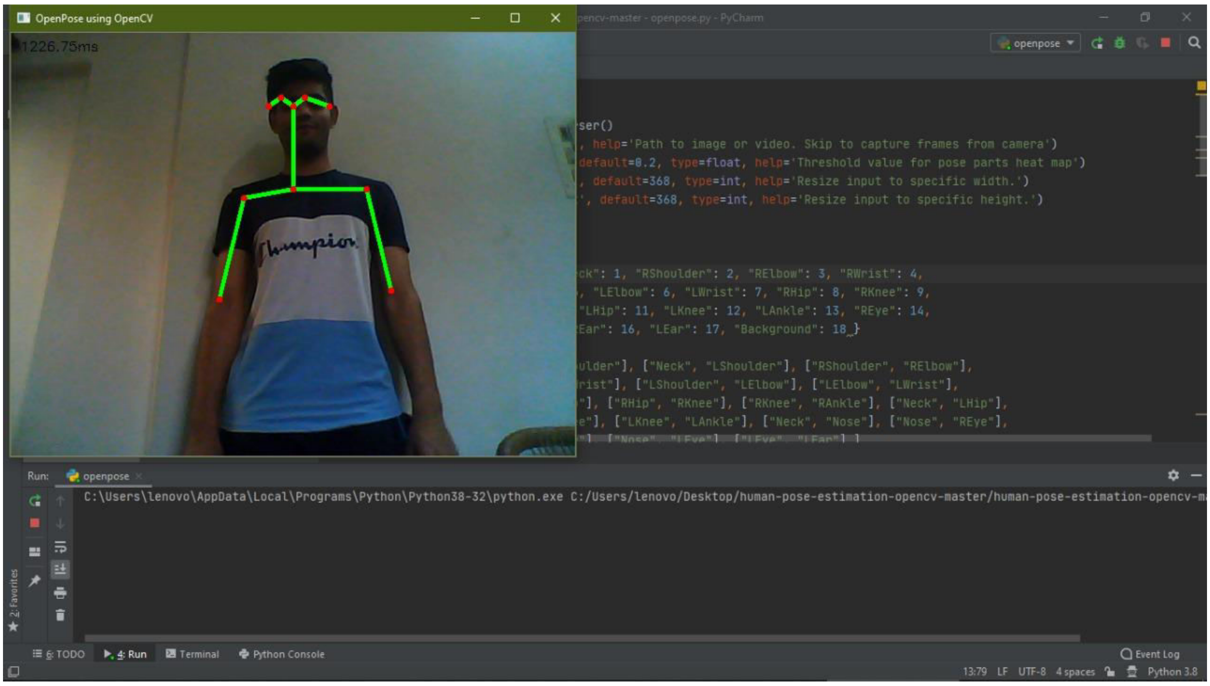
```
        idFrom = BODY_PARTS[partFrom]
        idTo = BODY_PARTS[partTo]

        if points[idFrom] and points[idTo]:
            cv.line(frame, points[idFrom], points[idTo], (0, 255, 0), 3)
            cv.ellipse(frame, points[idFrom], (3, 3), 0, 0, 360, (0, 0, 255),
cv.FILLED)
            cv.ellipse(frame, points[idTo], (3, 3), 0, 0, 360, (0, 0, 255),
cv.FILLED)

    t, _ = net.getPerfProfile()
    freq = cv.getTickFrequency() / 1000
    cv.putText(frame, '%.2fms' % (t / freq), (10, 20),
cv.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 0))

    cv.imshow('OpenPose using OpenCV', frame)
```

OUTPUT


OpenPose using OpenCV
1226.75ms
pencv-master - openpose.py - PyCharm
openpose
ser()
, help='Path to image or video. Skip to capture frames from camera')
default=0.2, type=float, help='Threshold value for pose parts heat map')
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', default=368, type=int, help='Resize input to specific height.')
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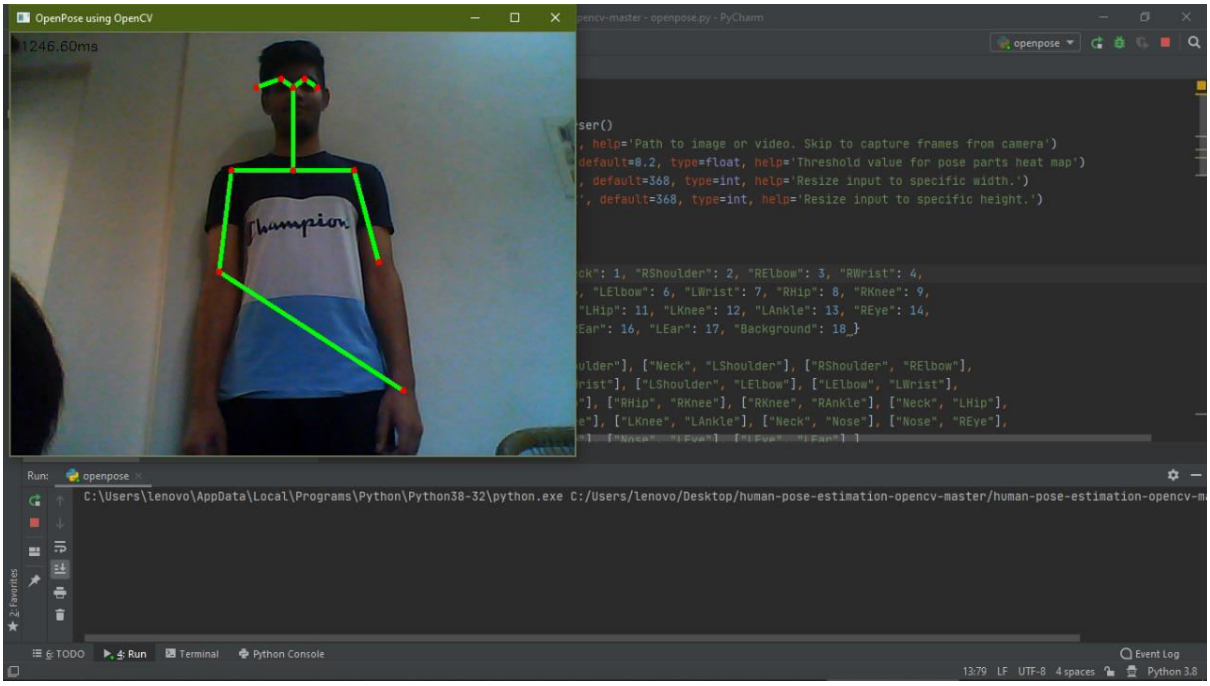
Run: openpose
C:\Users\lenovo\AppData\Local\Programs\Python\Python38-32\python.exe C:/Users/lenovo/Desktop/human-pose-estimation-opencv-master/human-pose-estimation-opencv-m
6: TODO
4: Run
Terminal
Python Console
Event Log
13:79 LF UTF-8 4 spaces Python 3.8


OpenPose using OpenCV
1246.60ms
pencv-master - openpose.py - PyCharm
openpose
ser()
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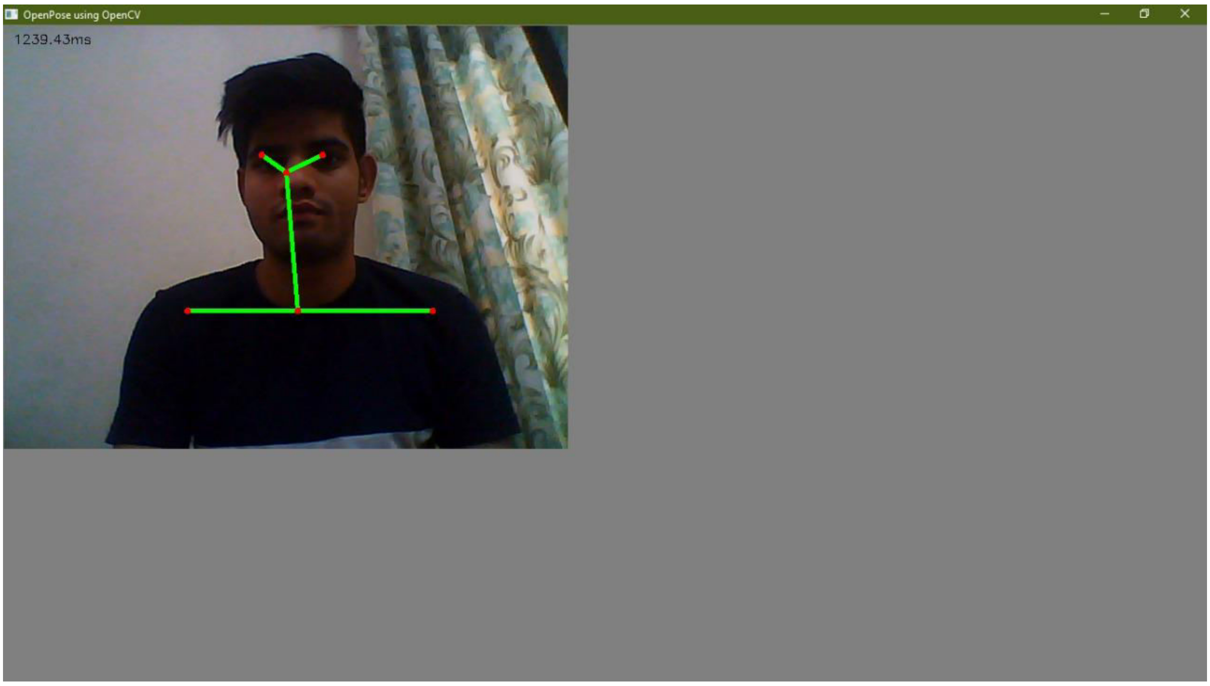
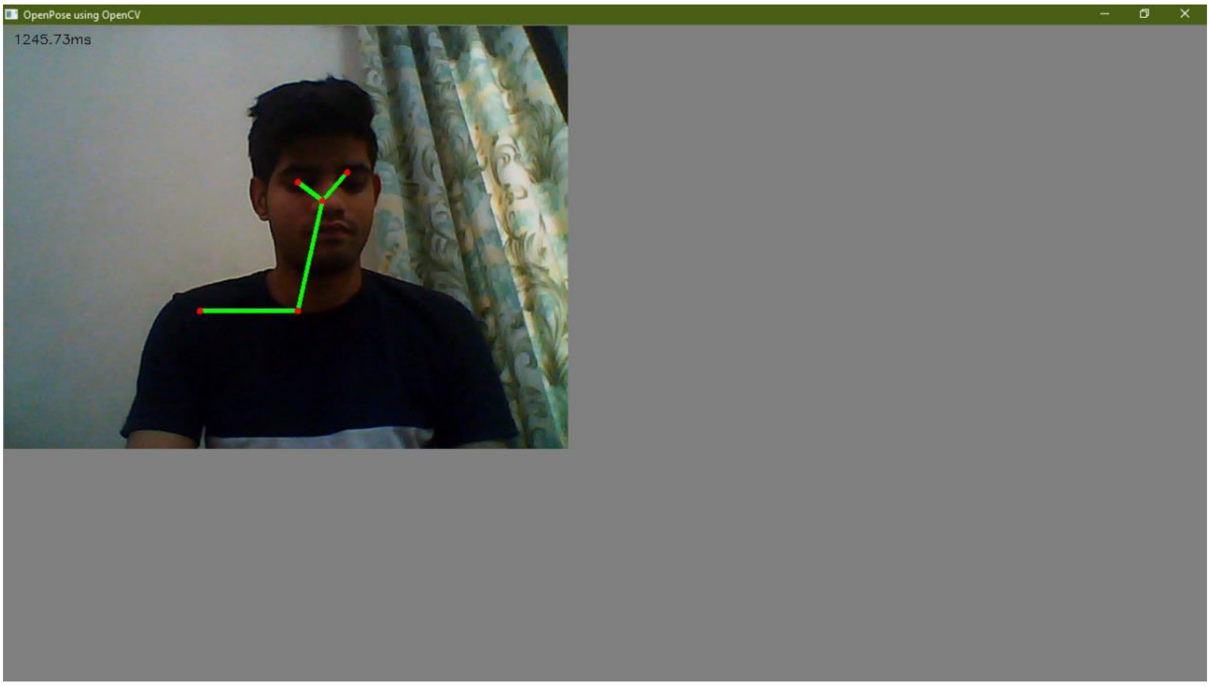
e"], ["LKnee", "LAnkle"], ["Neck", "Nose"], ["Nose", "REye"],
Run: openpose
C:\Users\lenovo\AppData\Local\Programs\Python\Python38-32\python.exe C:/Users/lenovo/Desktop/human-pose-estimation-opencv-master/human-pose-estimation-opencv-m
6: TODO
4: Run
Terminal
Python Console
Event Log
13:79 LF UTF-8 4 spaces Python 3.8

4. 0 Code and their outputes:

5.Github Link:





GIT HUB LINK :-

https://github.com/Sudershan11/AI-Project