Building the drowsiness detector with OpenCV

To start our implementation, open up a new file, name it detect_drowsiness.py.

Then import Necessary packages.(These are the modules which helps us to do our system)

```
#Import Necessary pack
from scipy.spatial import distance as dist
from imutils.video import VideoStream
from imutils import face_utils
from threading import Thread
import numpy as np
import pyglet
import argparse
import imutils
import time
import dlib
import cv2
from playsound import playsound
```

Import our required Python packages.

```
def sound_alarm(path):
      # play an alarm sound
      music = pyglet.resource.media(alarm.wav')
      music.play()
      pyglet.app.run()
```

This is used to import the alarm sound from our local system.

```
def eye_aspect_ratio(eye):
    # compute the euclidean distances between the two sets of
    # vertical eye landmarks (x, y)-coordinates
    A = dist.euclidean(eye[1], eye[5])
    B = dist.euclidean(eye[2], eye[4])
    # compute the euclidean distance between the horizon
    # eye landmark (x, y)-coordinates
    C = dist.euclidean(eye[0], eye[3])
    # compute the eye aspect ratio
    ear = (A + B) / (2.0 * C)
    # return the eye aspect ratio
    return ear
```

We also need to define the eye aspect ratio function which is used to compute the ratio of distances between the vertical eye landmarks and the distances between the horizontal eye landmark.

```
# define two constants, one for the eye aspect ratio to indicate
# blink and then a second constant for the number of consecutive
# frames the eye must be below the threshold for to set off the
# alarm
EYE_AR_THRESH = 0.3
EYE_AR_CONSEC_FRAMES = 48

# initialize the frame counter as well as a boolean used to
# indicate if the alarm is going off
COUNTER = 0
ALARM_ON = False
```

If the eye aspect ratio falls below this threshold (EYE_AR_THRESH), we'll start counting the number of frames the person has closed their eyes for.

If the number of frames the person has closed their eyes in exceeds, we'll sound an alarm.

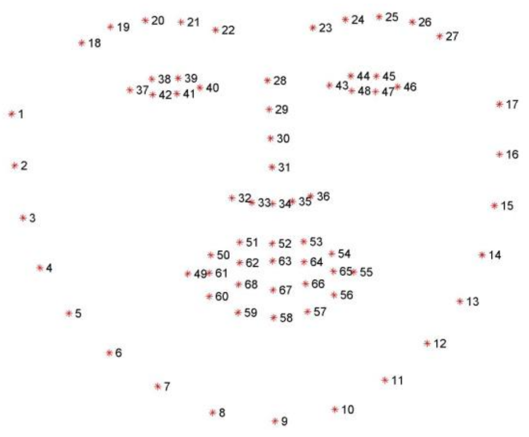
Experimentally, I've found that an EYE_AR_THRESH of 0.3 works well in a variety of situations

COUNTER, defines the total number of consecutive frames where the eye aspect ratio is below EYE_AR_THRESH. If COUNTER exceeds EYE_AR_CONSEC_FRAMES, then we'll update the boolean ALARM_ON.

The dlib library ships with a **Histogram of Oriented Gradients-based face detector** along with a **facial landmark predictor** (references for these two are attached at the end)— we instantiate both of these in the following code block:

```
# initialize dlib's face detector (HOG-based) and then create
# the facial landmark predictor
print("[INFO] loading facial landmark predictor...")
detector = dlib.get_frontal_face_detector()
predictor = dlib.shape_predictor("D:\cv\drowsiness-
detection\shape_predictor_68_face_landmarks.dat")
```

The facial landmarks produced by dlib are an indexable list, as I described here



Therefore, to extract the eye regions from a set of facial landmarks, we simply need to know the correct array slice indexes:

```
# grab the indexes of the facial landmarks for the left and
# right eye, respectively
(lStart, lEnd) = face_utils.FACIAL_LANDMARKS_IDXS["left_eye"]
(rStart, rEnd) = face_utils.FACIAL_LANDMARKS_IDXS["right_eye"]
```

Now we can start our core of our fatigue detector:

```
# start the video stream thread
print("[INFO] starting video stream thread...")
vs = VideoStream(src=args["webcam"]).start()
time.sleep(1.0)

# loop over frames from the video stream
while True:
    # grab the frame from the threaded video file stream, resize
    # it, and convert it to grayscale
    # channels)
    frame = vs.read()
    frame = imutils.resize(frame, width=450)
    gray = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)

    # detect faces in the grayscale frame
    rects = detector(gray, 0)
```

Here we instantiate our VideoStream using the supplied –webcam index, which then reads the next frame, which pre-process by resizing it to have a width of 450 pixels and converting it to grayscale, and then we apply dlib's face detector to find and locate the face in the image.

The next step is to apply facial landmark detection to localize each of the important regions of the face:

```
# loop over the face detections
    for rect in rects:
        # determine the facial landmarks for the face region, then
        # convert the facial landmark (x, y)-coordinates to a NumPy
        # array
        shape = predictor(gray, rect)
        shape = face_utils.shape_to_np(shape)

        # extract the left and right eye coordinates, then use the
        # coordinates to compute the eye aspect ratio for both eyes
        leftEye = shape[lStart:lEnd]
        rightEye = shape[rStart:rEnd]
        leftEAR = eye_aspect_ratio(leftEye)
        rightEAR = eye_aspect_ratio(rightEye)

        # average the eye aspect ratio together for both eyes
        ear = (leftEAR + rightEAR) / 2.0
```

We loop over each of the detected faces in our implementation (specifically related to driver drowsiness), we assume there is only *one* face — the driver — but I left this for loop in here just in case you want to apply the technique to videos with *more than one* face.

For each of the detected faces, we apply dlib's facial landmark detector and convert the result to a NumPy array

We can then *visualize* each of the eye regions on our frame by using the cv2.drawContours function below — this is often helpful when we are trying to debug our script and want to ensure that the eyes are being correctly detected.

```
# compute the convex hull for the left and right eye, then
# visualize each of the eyes
        leftEyeHull = cv2.convexHull(leftEye)
        rightEyeHull = cv2.convexHull(rightEye)
        cv2.drawContours(frame, [leftEyeHull], -1, (0, 255, 0), 1)
        cv2.drawContours(frame, [rightEyeHull], -1, (0, 255, 0), 1)
```

Finally, we are now ready to check to see if the person in our video stream is starting to show symptoms of drowsiness:

```
# check to see if the eye aspect ratio is below the blink
        # threshold, and if so, increment the blink frame counter
        if ear < EYE_AR_THRESH:
            COUNTER += 1

            # if the eyes were closed for a sufficient number of
            # then sound the alarm
            if COUNTER >= EYE_AR_CONSEC_FRAMES:
                # if the alarm is not on, turn it on
                if not ALARM_ON:
                    ALARM_ON = True
                # draw an alarm on the frame
                cv2.putText(frame, "DROWSINESS ALERT!", (10, 30),
                    cv2.FONT_HERSHEY_SIMPLEX, 0.7, (0, 0, 255), 2)
                playsound('alarm.wav')

        # otherwise, the eye aspect ratio is not below the blink
        # threshold, so reset the counter and alarm
        else:
            COUNTER = 0
            ALARM_ON = False
```

we make a check to see if the eye aspect ratio is below the "blink/closed" eye threshold, EYE_AR_THRESH.

If it is, we increment COUNTER, the total number of *consecutive frames* where the person has had their eyes closed.

To handle playing the alarm sound, provided an –alarm path was supplied when the script was executed. We take special care to create a *separate thread* responsible for calling sound_alarm to ensure that our main program isn't blocked until the sound finishes playing.

Next draw the text DROWSINESS ALERT! on our frame — again, this is often helpful for debugging, especially if you are not using the playsound library.

The final code block in our drowsiness detector handles displaying the output
Frame to our screen.

```
# draw the computed eye aspect ratio on the frame to help
        # with debugging and setting the correct eye aspect ratio
        # thresholds and frame counters
        cv2.putText(frame, "EAR: {:.2f}".format(ear), (300, 30),
            cv2.FONT_HERSHEY_SIMPLEX, 0.7, (0, 0, 255), 2)

    # show the frame
    cv2.imshow("Frame", frame)
    key = cv2.waitKey(1) & 0xFF

    # if the `q` key was pressed, break from the loop
    if key == ord("q"):
        break

# do a bit of cleanup
cv2.destroyAllWindows()
vs.stop()
```

Summary

We have seen the demonstration of how to build a drowsiness detector using OpenCV, dlib, and Python.

Our drowsiness detector hinged on two important computer vision techniques:

- Facial landmark detection
- Eye aspect ratio

Facial landmark prediction is the process of localizing key facial structures on a face, including the eyes, eyebrows, nose, mouth, and jawline.

Specifically, in the context of drowsiness detection, we only needed the eye regions Once we have our eye regions, we can apply the ***eye aspect ratio*** to determine if the eyes are closed. If the eyes have been closed for a sufficiently long enough period of time, we can assume the user is at risk of falling asleep and sound an alarm to grab their attention.