1. OpenCV (`cv2`)

- Purpose : Computer vision library for real-time image processing.

- Usage :

- Capturing video frames from a webcam (`cv2.VideoCapture`).

- Converting frames to grayscale (`cv2.cvtColor`).

- Drawing contours around detected eye regions (`cv2.drawContours`).

- Displaying the processed frames (`cv2.imshow`).

2. dlib

- Purpose : Machine learning library primarily used for real-time face detection and face landmark prediction.

- Usage :

- Detecting faces in the grayscale frames (`dlib.get\_frontal\_face\_detector`).

- Predicting facial landmarks (positions of eyes, nose, mouth, etc.) using a pre-trained model (`dlib.shape\_predictor`).

3. imutils

- Purpose : Convenience functions for image processing and computer vision tasks.

- Usage :

- Resizing the video frames (`imutils.resize`).

4. Scipy (`scipy.spatial.distance`)

- Purpose : Scientific computing library, used here for calculating Euclidean distance.

- Usage :

- Calculating the Eye Aspect Ratio (EAR) to determine whether the eyes are open or closed (`distance.euclidean`).

5. Twilio

- Purpose : Cloud communications platform for sending SMS, making calls, etc.

- Usage :

- Sending SMS alerts when drowsiness is detected (`twilio.rest.Client`).

6. sounddevice

- Purpose : Library for audio playback and recording.

- Usage :

- Playing an alert sound (`sd.play`) when drowsiness is detected.

7. NumPy (`numpy`)

- Purpose : Numerical computing library, used for handling arrays.

- Usage :

- Converting audio data from byte format to NumPy array for playback (`np.frombuffer`).

8. Standard Libraries

- `os` : Used for file path manipulation and checking if the model file exists.

- `time` : Used for time calculations, especially to measure how long the eyes have been closed.

- `wave` : Used for reading `.wav` audio files.

9. Pre-trained Model

- Path : `"models/shape\_predictor\_68\_face\_landmarks.dat"`

- Purpose : A pre-trained model for predicting 68 facial landmarks, used to locate the eyes and other facial features.

Key Functionalities:

1. Eye Aspect Ratio (EAR) Calculation :

- Determines if eyes are open or closed based on the ratio of distances between certain facial landmarks.

- If the EAR is below a threshold for a specified duration, drowsiness is detected.

2. Alert System :

- Sound Alert : Plays a sound file to alert the driver.

- SMS Alert : Sends an SMS message using Twilio.

3. Real-time Processing :

- Continuously captures and processes video frames in real-time, making it suitable for applications like driver monitoring.

Security Note

- The Twilio credentials (`account\_sid`, `auth\_token`, `twilio\_number`, `target\_number`) should be kept secure. Avoid hardcoding sensitive information in the code. Use environment variables or secure vaults instead.

This combination of technologies provides a robust system for detecting driver drowsiness and alerting the driver or others, enhancing safety in driving scenarios.