→ Eye Blink detection algorithms !-

① Detecting eye Blink with facial landmark

→ Python's dlib library uses Kazemi and Sullivan's one millisecond face alignment with an Ensemble of Regression Tree.

- The program uses priors to estimate the probable distance between keypoints.

- This library outputs a 68 points on a given input image.
- for eye blink we need to pay attention to points 37 – 46.

→ Clmtrackr is another facial landmark plotter -

② Detecting Eye Blinks with frame differencing

frame differencing is another blink detection techniques.

→ A program compare subsequent video frame to determine if there was any movement in a selected eye region.

→ Viola - Jone face detector

→ The program then computes the difference the eye region of interests in subsequent frame. Any pixel that are different can plotted on a seprate image.

• Demonstrates a program using frame differencing to detect hand movement. A Binary threshold and gaussian Blur filter the image.

3] Detecting Eye Blink with pupil detection

• The program starts off by placing a bounding box on any detected face within a region of interest. The program then detects general eye regions within the face bounding box.

Anti-Spoofing

Blink detector :- Eye aspect ratio (EAR)

Traditional image processing :-

1 → Eye localization
2 → Thresholding to find the whites of the eyes.
3 → Determining if the "white" region of the eyes disappear for a period of time.

Eye Aspect Ratio (EAR) :- The eye aspect ratio is a constant value, but rapidly falls to 0 when the eye is closed.

Q-1 How to ~~design~~ decide the value of EAR ?

- we can apply facial landmark detection to localize important region of the face, including eyes, eyebrows, nose, ears and mouth !
- SVM classifier detect eye blink as a pattern of EAR value in short temporal window.

Viola-Jones type detector

major drawbacks :-

1) Relative face-camera pose (head orientation)
2) image resolution, illumination, motion dynamics etc.
3) Raw image intensity are likely to very sensitive

→ Most of the state-of-the-art landmark detectors formulate a regression problem, where mapping from image into landmark positions or into other landmark-parameterization is learned.

→ Average error of landmark localization of a state-of-the-art detector is usually below five percent of inter-ocular distance.

[The inter-ocular distance (IOD) is a measurement b/w the two medial canthi of each eye.

[It is often measured as an necessary biometric parameter on routine antenatal ultrasound scans on the axial images.

[Increased interocular distance hypertelorism.
[decrease " hypotelorism.

• A single scalar quantity that reflect a level of the eye opening is derived from landmarks. The eye blink are found by an SVM classifier that is trained on eye blinking and non-blinking patterns.

- facial segmentation model presented, their system is based on active shape models with reported processing time of about 5 seconds per frame. for the segmentation

→ the proposed algorithm run real-time, since the extra costs of eye opening from land-marks and linear SVM are negligible.

2.1 Description of feature:-

for every video frame, the eye landmark are detected. The eye aspect ratio (EAR) b/w hight and width of the eye is computed.

$$EAR = \frac{\|P_2 - P_6\| + \|P_3 - P_5\|}{2\|P_1 - P_4\|}$$

2.2 Classification

- A low value of the EAR may occur when a subject closes his/her eye intentionally for a longer time
- we propose a classifier that takes a larger temporal window of frame as an input (30 ± 6) fps
- Each time, a 13-dimensional feature is gather by concatenating the EARs of its ± 6 neighbouring frames

- This is implemented by a linear SVM classifier trained from manually annotated sequence
- Positive example are collected as ground-truth blinks, while the negative are those that are sampled from the video where no blink occurs, with 5 frame sparing and 7 frames margin.
- Testing, a classifier is executing in scanning-window fashion.

3.1 Accuracy of landmark detector :- (300-VW dataset)

- The accuracy of landmark detection for a face image is measured by average relative ~~notion~~ landmark localization error, def

$$\epsilon = \frac{100}{kN} \sum_{i=1}^{N} \|x_i - \hat{x}_i\|_2$$

~~N is a number of landmarks location by a detector~~

~~N is a number of landmark location~~

N is a number of landmarks and normalization factor k is the inter-ocular distance (IOD)

we measured a mean localization error u as a function of a face image resolution determined by IOD.

$$u = \frac{1}{|S|} \sum_{j \in S} \varepsilon_j$$

3.2 Eye blink detector evaluation (ZJU dataset)