Eye-Tracking Classification

Fall 2021 Group 16

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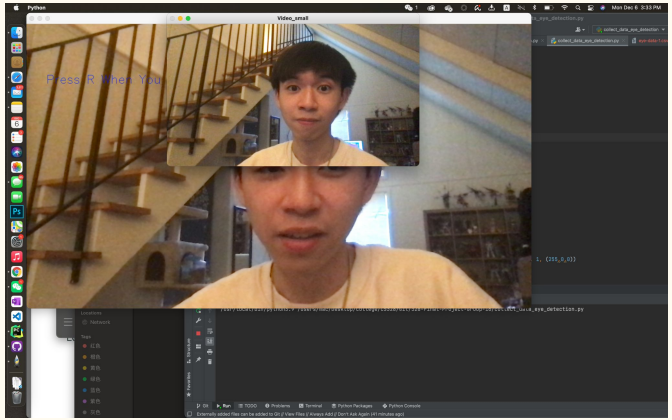
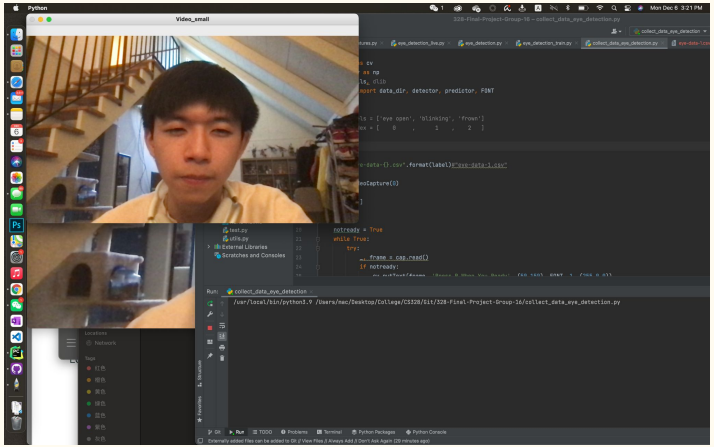
New Goal: Using eye-tracker to classify eye activities

- Eye Open
- Eye Close
- Blinking
- Staring
- Frown

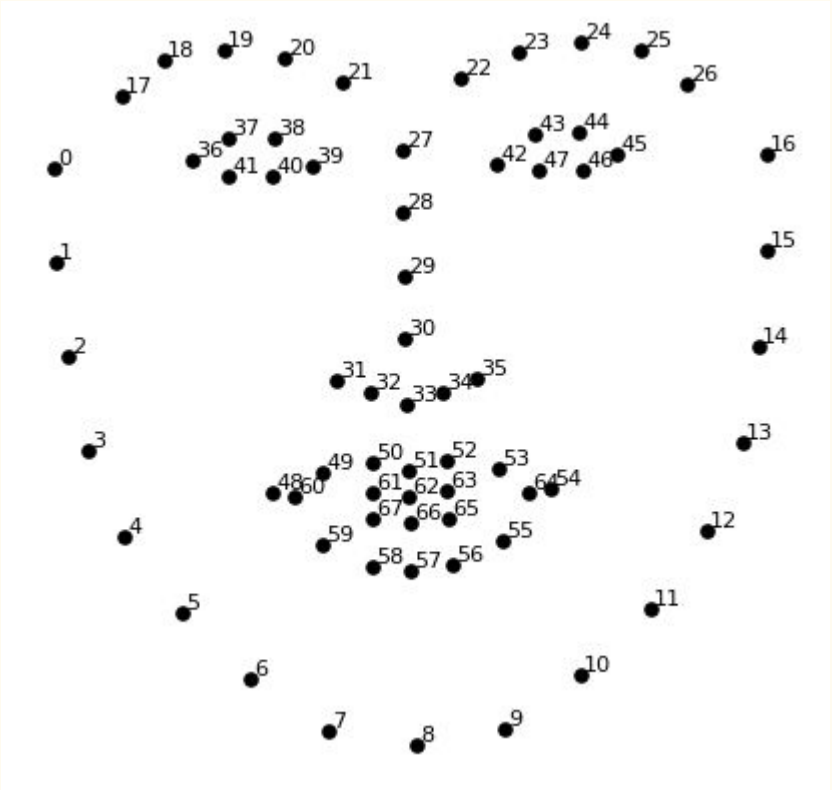
How we collect data





Model Selection and Data analysis

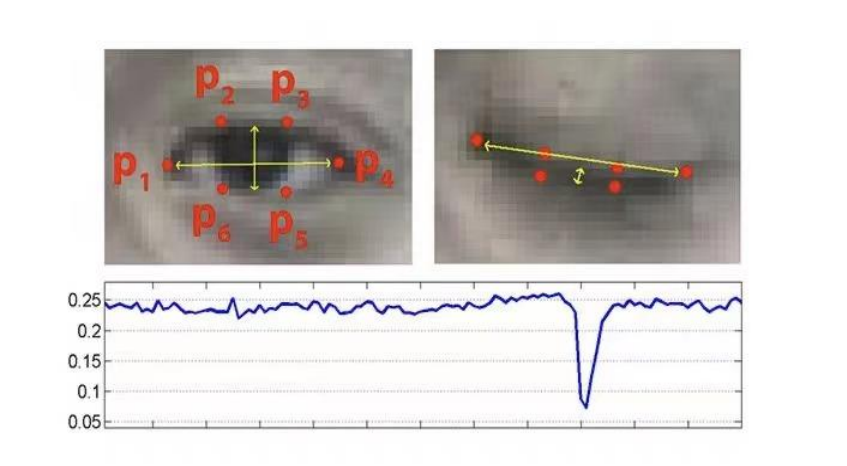
- API
  - CV2 (openCV)
- Features
  - Eyes vertical ratio
  - Eyes Ratio
  - Eyes Ratio Variance
  - etc
- Classification
  - Decision Tree from Sklearn
  - cross-validation for accuracy



Feature: Eyes Ratio

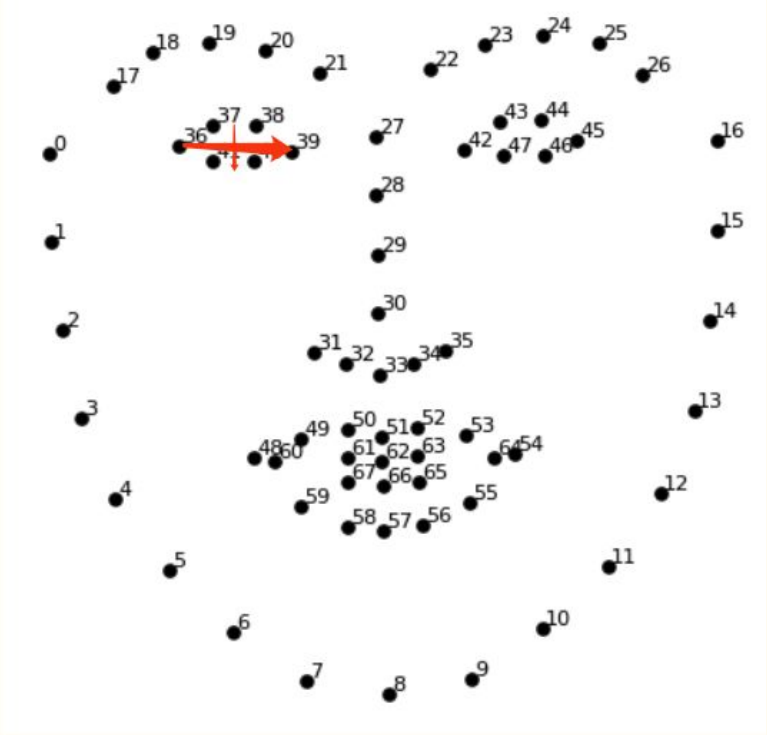
- Ratio =

$$\frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$



Feature: Max Difference of eye ratio in frames

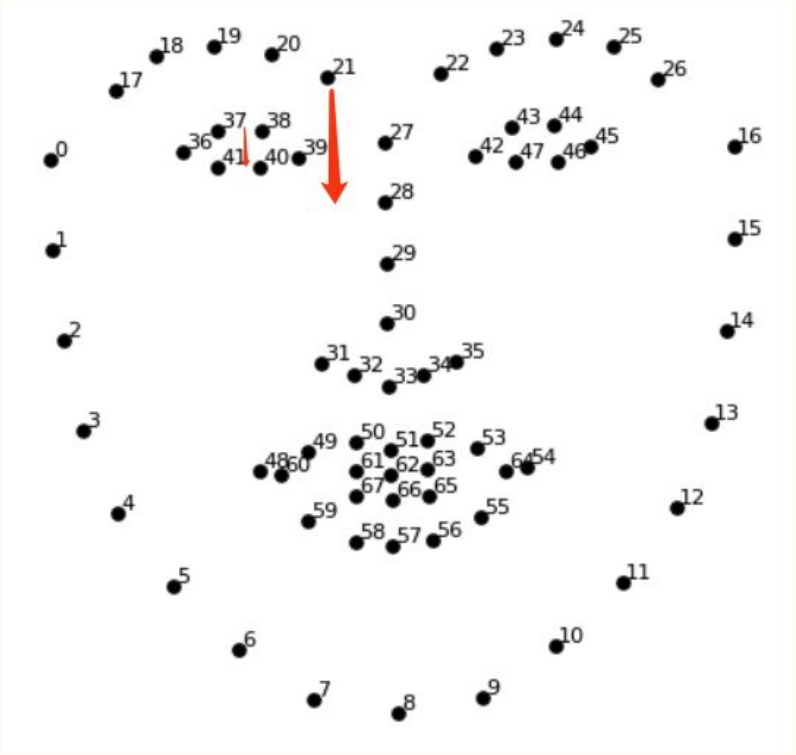
We extract the minimal and maximum eye raito(by using the formula for previous slide) though the 22 frames and take the difference between the ratios.



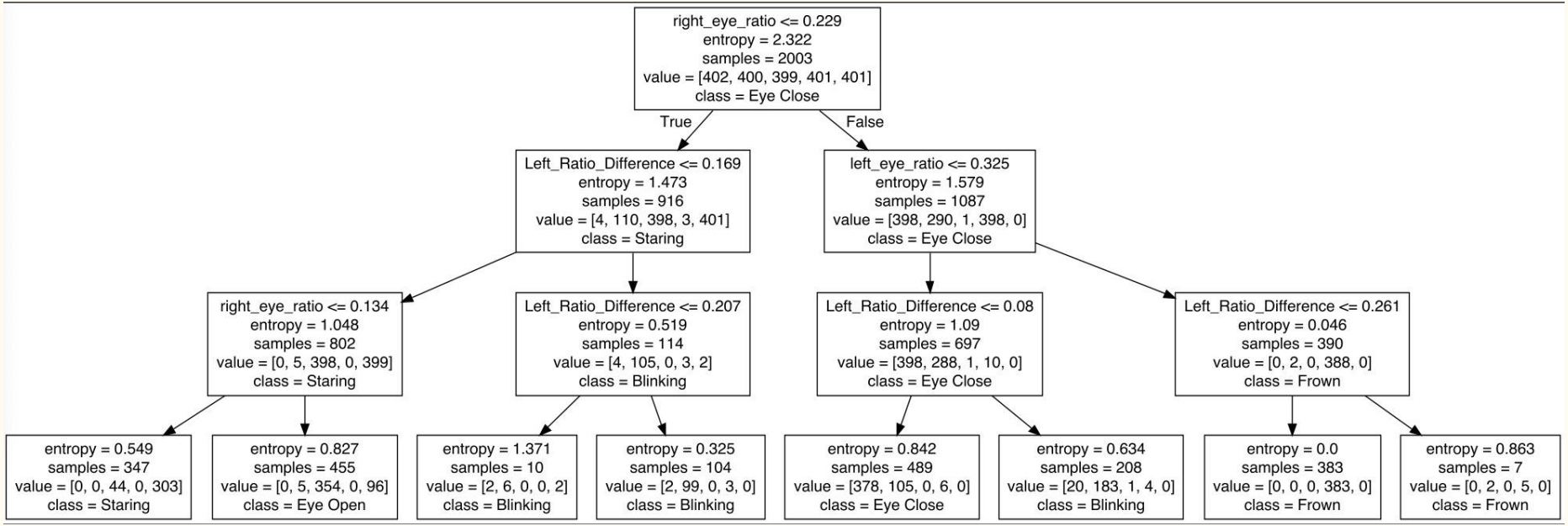
Feature: Eye Vertical Ratio

We using the ratio between face distance (index 21 and index 28) and vertical length (index 37 and index 38 for left eye, index 40 and index 41 for right eye) and take the average for both eyes and take the ratio by divide by face distance.

i.e: (|frame[37][y] - frame[38][y]|+|frame[40][1]-frame[41][1]|/ 2) /|frame[21][y]-fram[28][y]|



Decision Tree



Decision Tree Explanation

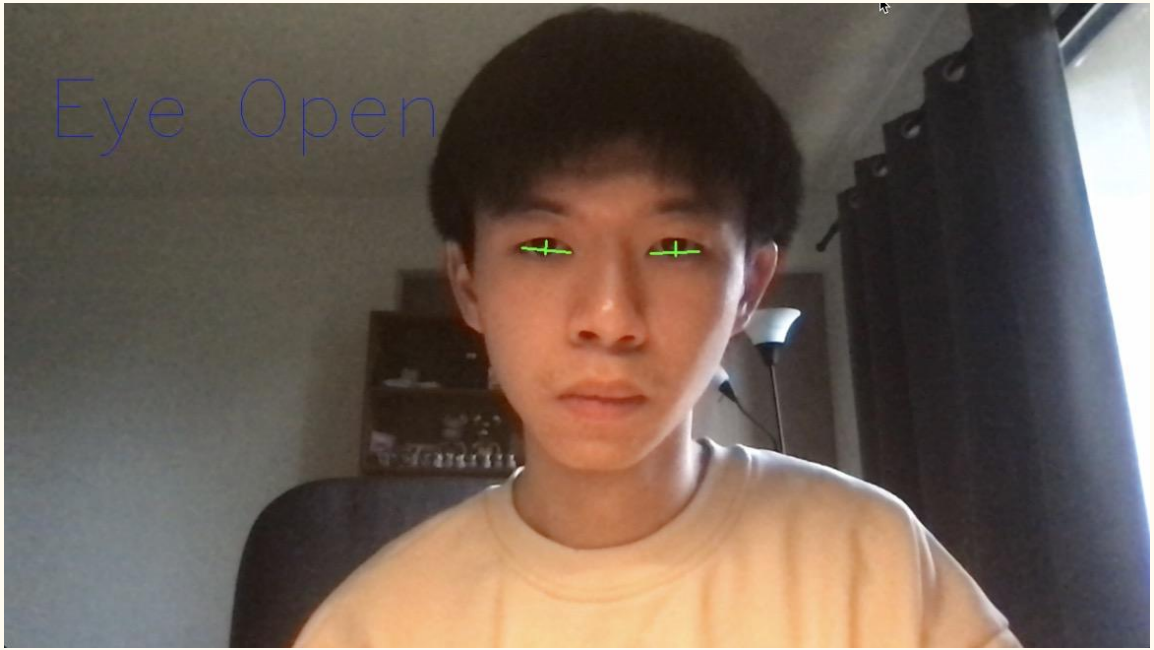
From the decision tree picture, we can see that the eye aspect ratio was the main factor determining the decision. Majorly blinking and a frown formed the right subtree, and open eye staring formed the left subtree. When the eye aspect ratio of the open eye and staring is the difference as the aspect ratio of eye close and frown. And From depth 2, we can see that the decision tree used aspect ratio difference to determine blink. Because blinking is dynamic, we could not just use one ratio to select it. Therefore, the eye aspect ratio has been used here(since the aspect ratio difference happens during a period similar to eye blink).

Confusion Matrix, Accuracy, Precision and Recall

```
Fold: 10
Confusion Matrix:
[[58  3  0  0  0]
 [ 7 33  0  0  1]
 [ 0  0 24  0  2]
 [ 0  2  0 36  0]
 [ 0  1  2  0 31]]
Average Accuracy:  0.91
Precision Value:  0.91
Recall Value:  0.91
```

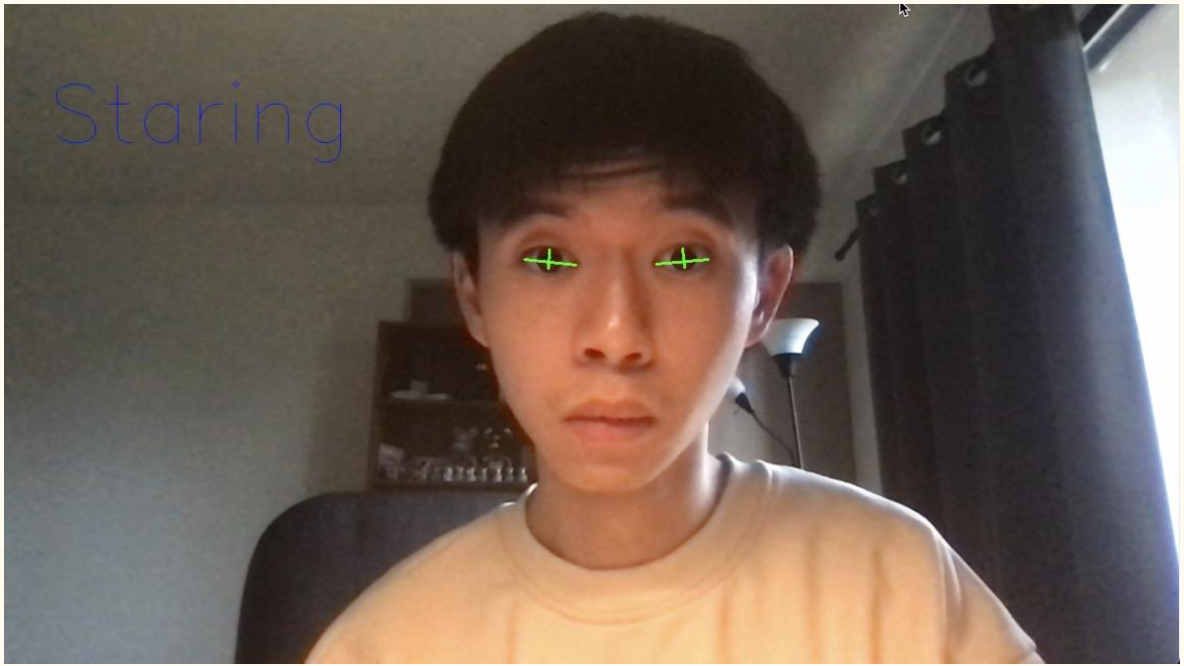
Open Eye Live Prediction

Eye Open



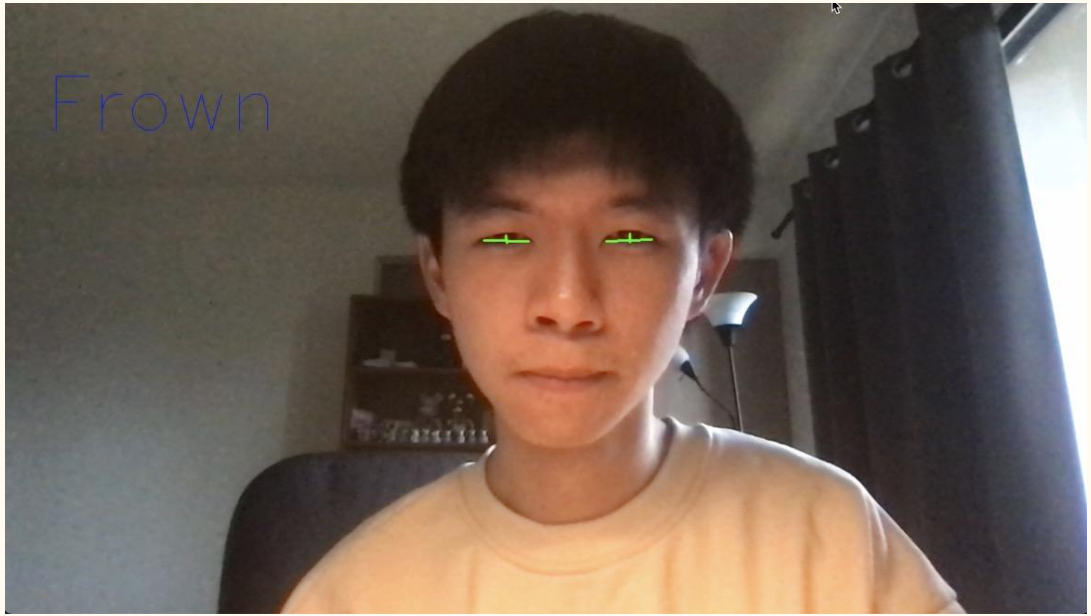
Blinking Live Prediction

Staring



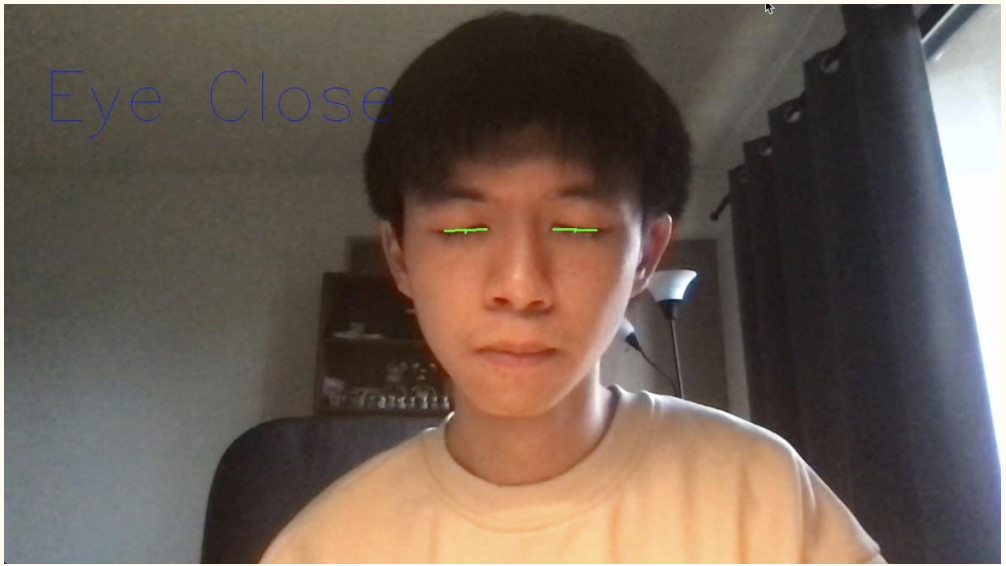
Frown Live Prediction

Frown



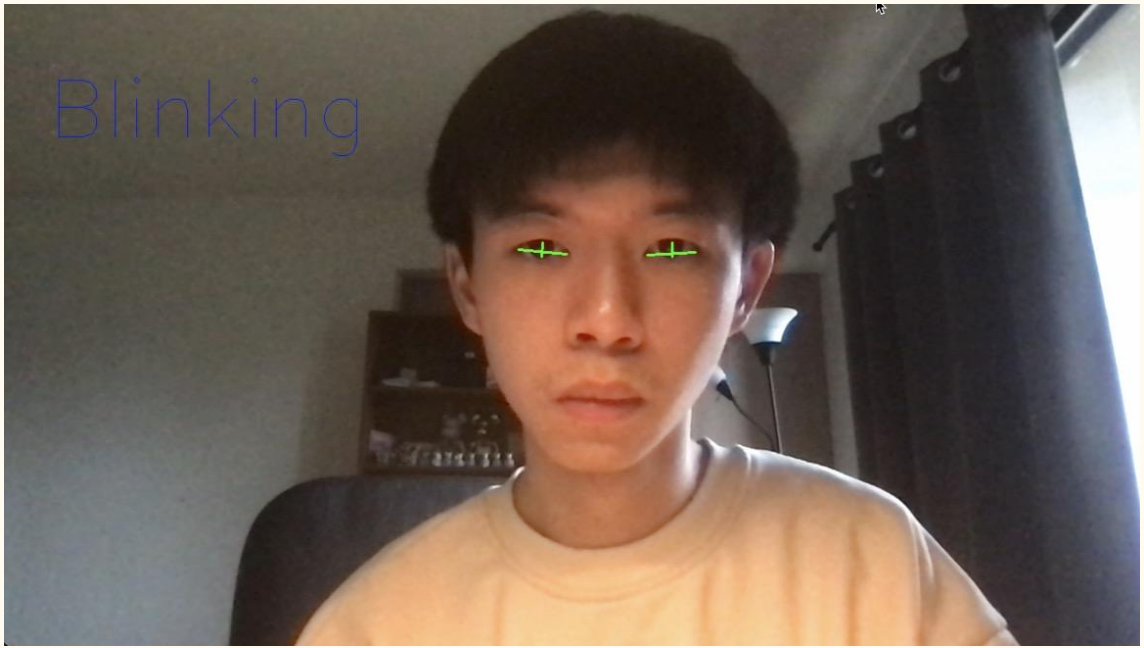
Staring Live Prediction

Eye Close



Close Eye Live Prediction

Blinking



Thanks for you time!
Question?