

# Cool Real-time Video

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## 1 Introduction

Covid-19 has made many works and studies move online, people often need to record videos or attend online meetings, how to make yourself looks better in a real-time video?

The goal for this project is to make a simple GUI that can add some widget on your face and replace the background of the real-time video. The final effect should look as if you are wearing sunglasses on a beach, although you are just sitting at home recording a video!

## 2 Proposed solution

### 2.1 Wearing sunglasses

#### 2.1.1 Face Detector

The face detector of package dlib is used, which leverages the Histogram of Oriented Gradients (HOG) feature combined with a linear classifier, an image pyramid, and sliding window detection scheme and can detect multiple faces. It is often more accurate than openCV's face detector, but it consumes more time. Pre-trained 68 face landmarks[1] are used to predict the feature points around eyes, including the size and center of mass for each eye, to get a good fit of the sunglasses.

#### 2.1.2 Modify and Paste the Sunglasses

The sunglasses image is then resized and rotated to fit the shape of eyes and the angle between two eye centroids. Finally, it is pasted to the video in real-time.

In order to make the video looks smoother and avoid the sunglasses flashing rapidly, since there will be lag caused by computation time, all above process will be done each 3 frames (0.1s since my webcam is 30fps). For the rest of the frames, it will use

exactly the same location, size and angle of their previous sunglasses. Also, the real-time images are first transformed into gray images for faster fitting.

## 2.2 Replace Background

### 2.2.1 MOG2 Background Subtractor - the result is not ideal

I first tried MOG2 Background Subtractor, which isolates moving items from static background. However, if you just sit there without strenuous exercise, it will regard most of your face, expect for your blinking eyes, as a part of the static background as well.

### 2.2.2 Canny Edge Detector

Then I use Canny Edge Detector to get the contours of the human body and face. This algorithm can be broken down to 5 different steps:

1. Apply Gaussian filter to smooth the image in order to remove the noise.
2. Find the intensity gradients of the image.
3. Apply non-maximum suppression to get rid of spurious response to edge detection.
4. Apply double threshold to determine potential edges.
5. Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

### 2.2.3 Create and Blend mask into New Background

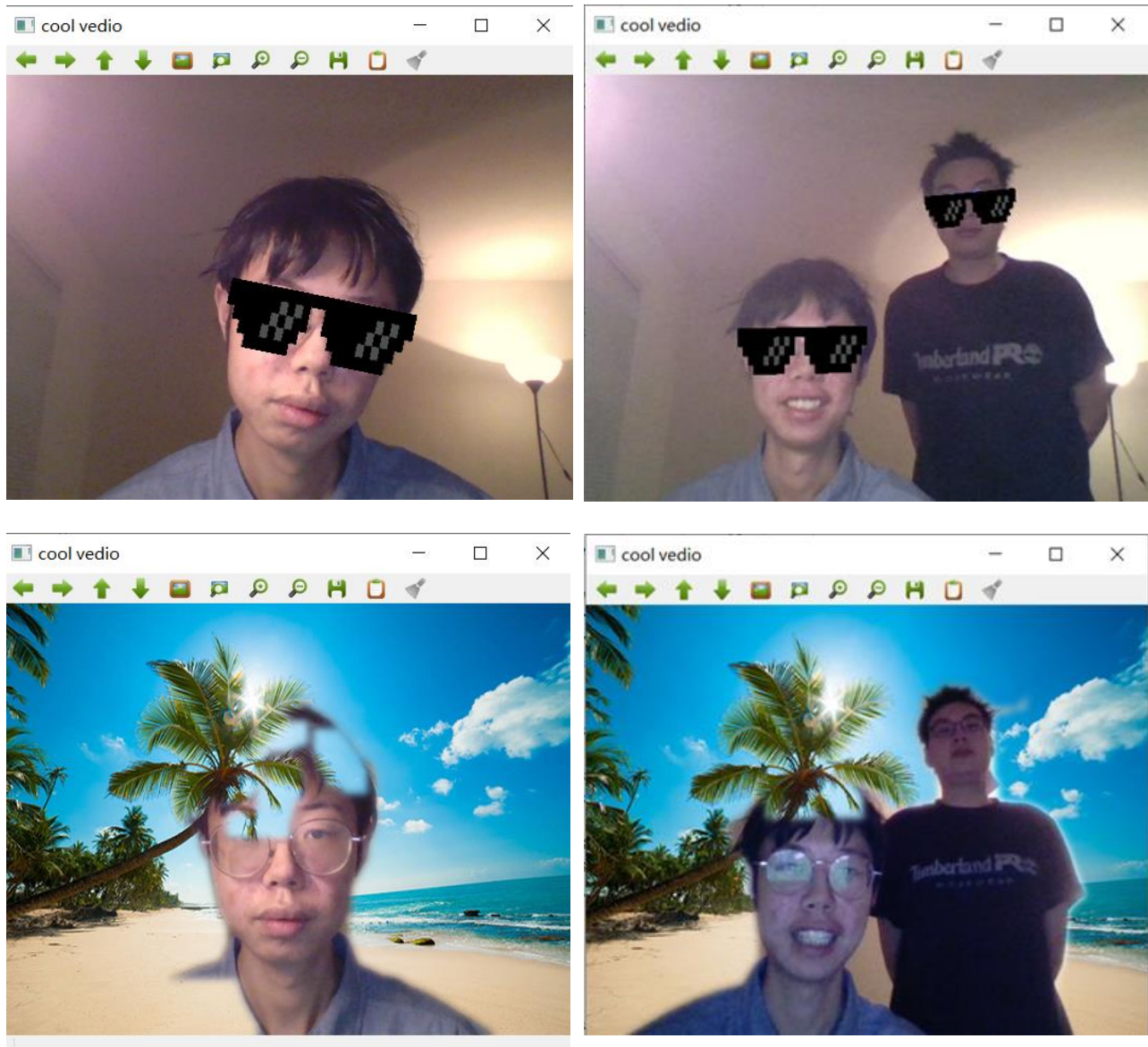
First, filled polygons, corresponding to contours in the edges detected by Canny, are drawn on an empty mask. Next, the mask is smoothed by dilating and eroding nearby area and blurred by Gaussian filtering. Finally, the mask is pasted into a new background in real-time.

Also, all above process will be done each 3 frames like 2.1.2 to avoid flashing.

## 3 Results and summary

A simple GUI is made to show a real-time video with sunglasses wearing and background replacement through user's webcam. Users can press 'g' on their

keyboard to start or stop wearing sunglasses, press 'r' to start or stop replacing the background into beach, and press 'q' to quit. Below are the results.



As it shows, the sunglasses fit quite well even when I turned my head to one side. However, the background replacement need improve. It sometimes treats part of my clothes and hair as background on the condition of single side light source. I tried tune some parameters of Canny like the upper and lower threshold, but it helped little on this. Maybe I should try some algorithms other than MOG2 Background Subtractor and Canny Edge Detector in the future.

[1] [http://dlib.net/files/shape\\_predictor\\_68\\_face\\_landmarks.dat.bz2](http://dlib.net/files/shape_predictor_68_face_landmarks.dat.bz2)