Google Colab: Access Webcam for Images and Video

This notebook will go through how to access and run code on images and video taken using your webcam.

For this purpose of this tutorial we will be using OpenCV's Haar Cascade to do face detection on our Webcam image and video.

```
# import dependencies
from IPython.display import display, Javascript, Image
from google.colab.output import eval_js
from base64 import b64decode, b64encode
import cv2
import numpy as np
import PIL
import io
import html
import time
```

Helper Functions

Below are a few helper function to make converting between different image data types and formats.

```
# function to convert the JavaScript object into an OpenCV image
def js_to_image(js_reply):
  """
  Params:
          js_reply: JavaScript object containing image from webcam
  Returns:
          img: OpenCV BGR image
  """
  # decode base64 image
  image_bytes = b64decode(js_reply.split(',')[1])
  # convert bytes to numpy array
  jpg_as_np = np.frombuffer(image_bytes, dtype=np.uint8)
  # decode numpy array into OpenCV BGR image
  img = cv2.imdecode(jpg_as_np, flags=1)

  return img

# function to convert OpenCV Rectangle bounding box image into base64 byte string to be overlayed on video str
def bbox_to_bytes(bbox_array):
  """
  Params:
          bbox_array: Numpy array (pixels) containing rectangle to overlay on video stream.
  Returns:
        bytes: Base64 image byte string
  """
  # convert array into PIL image
  bbox_PIL = PIL.Image.fromarray(bbox_array, 'RGBA')
  iobuf = io.BytesIO()
  # format bbox into png for return
  bbox_PIL.save(iobuf, format='png')
  # format return string
  bbox_bytes = '{}'.format((str(b64encode(iobuf.getvalue()), 'utf-8')))

  return bbox_bytes
```

Haar Cascade Classifier

For this tutorial we will run a simple object detection algorithm called Haar Cascade on our images and video fetched from our webcam. OpenCV has a pre-trained Haar Cascade face detection model.

```
# initialize the Haar Cascade face detection model
face_cascade = cv2.CascadeClassifier(cv2.samples.findFile(cv2.data.haarcascades + 'haarcascade_frontalface_def
```

Webcam Images

Running code on images taken from webcam is fairly straight-forward. We will utilize code within Google Colab's **Code Snippets** that has a variety of useful code functions to perform various tasks.

We will be using the code snippet for **Camera Capture** to utilize your computer's webcam.

```
def take_photo(filename='photo.jpg', quality=0.8):
  js = Javascript('''
    async function takePhoto(quality) {
      const div = document.createElement('div');
      const capture = document.createElement('button');
      capture.textContent = 'Capture';
      div.appendChild(capture);

      const video = document.createElement('video');
      video.style.display = 'block';
      const stream = await navigator.mediaDevices.getUserMedia({video: true});

      document.body.appendChild(div);
      div.appendChild(video);
      video.srcObject = stream;
      await video.play();

      // Resize the output to fit the video element.
      google.colab.output.setIframeHeight(document.documentElement.scrollHeight, true);

      // Wait for Capture to be clicked.
      await new Promise((resolve) => capture.onclick = resolve);

      const canvas = document.createElement('canvas');
      canvas.width = video.videoWidth;
      canvas.height = video.videoHeight;
      canvas.getContext('2d').drawImage(video, 0, 0);
      stream.getVideoTracks()[0].stop();
      div.remove();
      return canvas.toDataURL('image/jpeg', quality);
    }
    ''')
  display(js)

  # get photo data
  data = eval_js('takePhoto({})'.format(quality))
  # get OpenCV format image
  img = js_to_image(data)
  # grayscale img
  gray = cv2.cvtColor(img, cv2.COLOR_RGB2GRAY)
  print(gray.shape)
  # get face bounding box coordinates using Haar Cascade
  faces = face_cascade.detectMultiScale(gray)
  # draw face bounding box on image
  for (x,y,w,h) in faces:
      img = cv2.rectangle(img,(x,y),(x+w,y+h),(255,0,0),2)
  # save image
  cv2.imwrite(filename, img)

  return filename
```

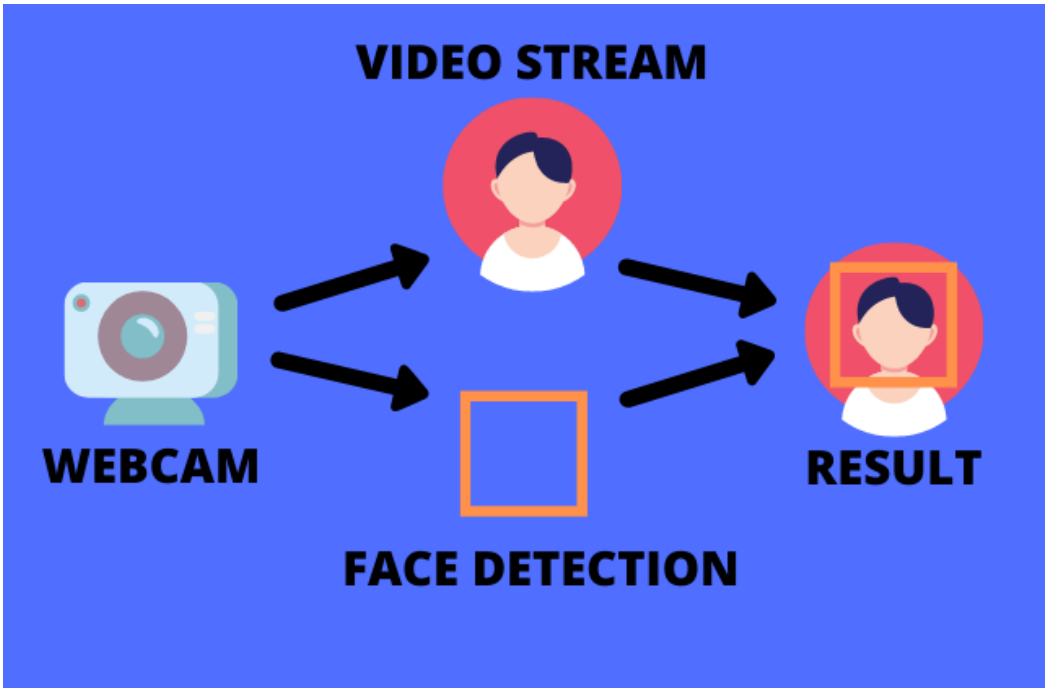
```
try:
  filename = take_photo('photo.jpg')
  print('Saved to {}'.format(filename))

  # Show the image which was just taken.
  display(Image(filename))
except Exception as err:
  # Errors will be thrown if the user does not have a webcam or if they do not
  # grant the page permission to access it.
  print(str(err))
```

```
NotAllowedError: Permission denied
```

Webcam Videos

Running code on webcam video is a little more complex than images. We need to start a video stream using our webcam as input. Then we run each frame through our progam (face detection) and create an overlay image that contains bounding box of detection(s). We then overlay the bounding box image back onto the next frame of our video stream.




```
# JavaScript to properly create our live video stream using our webcam as input
def video_stream():
  js = Javascript('''
    var video;
    var div = null;
    var stream;
    var captureCanvas;
    var imgElement;
    var labelElement;

    var pendingResolve = null;
    var shutdown = false;

    function removeDom() {
       stream.getVideoTracks()[0].stop();
       video.remove();
       div.remove();
       video = null;
       div = null;
       stream = null;
```

```
    imgElement = null;
    captureCanvas = null;
    labelElement = null;
}

function onAnimationFrame() {
  if (!shutdown) {
    window.requestAnimationFrame(onAnimationFrame);
  }
  if (pendingResolve) {
    var result = "";
    if (!shutdown) {
      captureCanvas.getContext('2d').drawImage(video, 0, 0, 640, 480);
      result = captureCanvas.toDataURL('image/jpeg', 0.8)
    }
    var lp = pendingResolve;
    pendingResolve = null;
    lp(result);
  }
}

async function createDom() {
  if (div !== null) {
    return stream;
  }

  div = document.createElement('div');
  div.style.border = '2px solid black';
  div.style.padding = '3px';
  div.style.width = '100%';
  div.style.maxWidth = '600px';
  document.body.appendChild(div);

  const modelOut = document.createElement('div');
  modelOut.innerHTML = "<span>Status:</span>";
  labelElement = document.createElement('span');
  labelElement.innerText = 'No data';
  labelElement.style.fontWeight = 'bold';
  modelOut.appendChild(labelElement);
  div.appendChild(modelOut);

  video = document.createElement('video');
  video.style.display = 'block';
  video.width = div.clientWidth - 6;
  video.setAttribute('playsinline', '');
  video.onclick = () => { shutdown = true; };
  stream = await navigator.mediaDevices.getUserMedia(
      {video: { facingMode: "environment"}});
  div.appendChild(video);

  imgElement = document.createElement('img');
  imgElement.style.position = 'absolute';
  imgElement.style.zIndex = 1;
  imgElement.onclick = () => { shutdown = true; };
  div.appendChild(imgElement);

  const instruction = document.createElement('div');
  instruction.innerHTML =
      '<span style="color: red; font-weight: bold;">' +
      'When finished, click here or on the video to stop this demo</span>';
  div.appendChild(instruction);
  instruction.onclick = () => { shutdown = true; };

  video.srcObject = stream;
  await video.play();

  captureCanvas = document.createElement('canvas');
  captureCanvas.width = 640; //video.videoWidth;
```

```
          captureCanvas.height = 480; //video.videoHeight;
          window.requestAnimationFrame(onAnimationFrame);

          return stream;
        }
        async function stream_frame(label, imgData) {
          if (shutdown) {
            removeDom();
            shutdown = false;
            return '';
          }

          var preCreate = Date.now();
          stream = await createDom();

          var preShow = Date.now();
          if (label != "") {
            labelElement.innerHTML = label;
          }

          if (imgData != "") {
            var videoRect = video.getClientRects()[0];
            imgElement.style.top = videoRect.top + "px";
            imgElement.style.left = videoRect.left + "px";
            imgElement.style.width = videoRect.width + "px";
            imgElement.style.height = videoRect.height + "px";
            imgElement.src = imgData;
          }

          var preCapture = Date.now();
          var result = await new Promise(function(resolve, reject) {
            pendingResolve = resolve;
          });
          shutdown = false;

          return {'create': preShow - preCreate,
                  'show': preCapture - preShow,
                  'capture': Date.now() - preCapture,
                  'img': result};
        }
        ''')

      display(js)

    def video_frame(label, bbox):
      data = eval_js('stream_frame("{}", "{}")'.format(label, bbox))
      return data


    # start streaming video from webcam
    video_stream()
    # label for video
    label_html = 'Capturing...'
    # initialze bounding box to empty
    bbox = ''
    count = 0
    while True:
        js_reply = video_frame(label_html, bbox)
        if not js_reply:
            break

        # convert JS response to OpenCV Image
        img = js_to_image(js_reply["img"])

        # create transparent overlay for bounding box
        bbox_array = np.zeros([480,640,4], dtype=np.uint8)

        # grayscale image for face detection
```

```
    gray = cv2.cvtColor(img, cv2.COLOR_RGB2GRAY)

    # get face region coordinates
    faces = face_cascade.detectMultiScale(gray)
    # get face bounding box for overlay
    for (x,y,w,h) in faces:
      bbox_array = cv2.rectangle(bbox_array,(x,y),(x+w,y+h),(255,0,0),2)

    bbox_array[:,:,3] = (bbox_array.max(axis = 2) > 0 ).astype(int) * 255
    # convert overlay of bbox into bytes
    bbox_bytes = bbox_to_bytes(bbox_array)
    # update bbox so next frame gets new overlay
    bbox = bbox_bytes
```

Hope You Enjoyed!

If you enjoyed the tutorial and want to see more videos or tutorials check out my YouTube channel HERE

Have a great day!