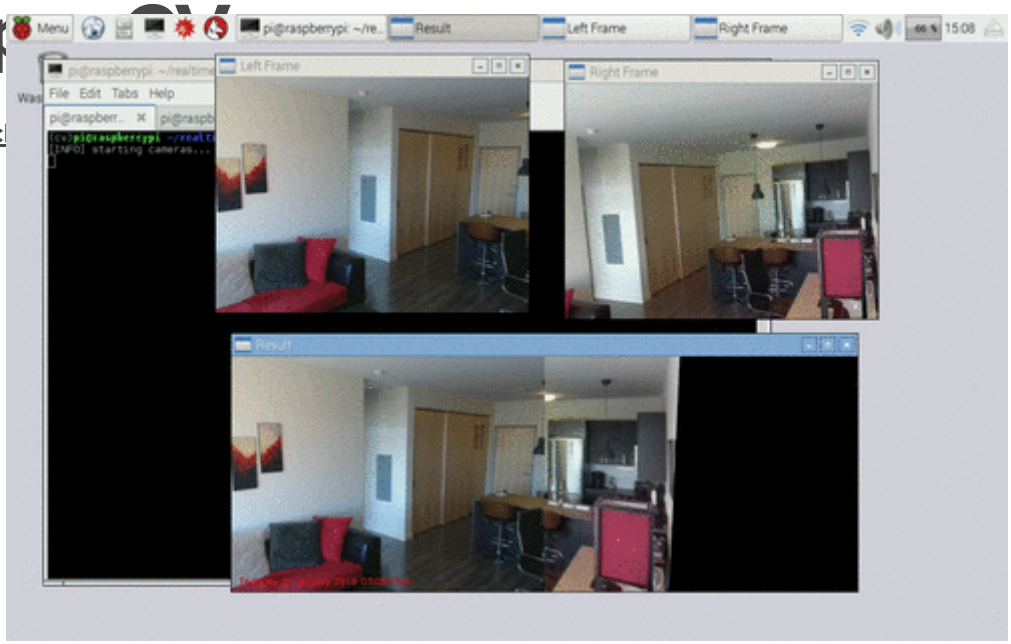
Real-time panorama and image stitching with Op CV

by Adrian Rosebroc



(https://pyimagesearch.com/wp-content/uploads/2016/01/realtime_panorama_stitching_animation.gif)

One of my favorite parts of running the PyImageSearch blog is a being able to *link together previous blog posts* and *create a solution to a particular problem* — ***in this case, real-time panorama and image stitching with Python and OpenCV.***

Over the past month and a half, we've learned how to **increase the FPS processing rate of builtin/USB webcams (https://pyimagesearch.com/2015/12/21/increasing-webcam-fps-with-python-and-opencv/)** and the **Raspberry Pi camera module (https://pyimagesearch.com/2015/12/28/increasing-raspberry-pi-fps-with-python-and-opencv/)**. We also learned how to **unify access to *both* USB webcams and the Raspberry Pi camera into a *single class* (https://pyimagesearch.com/2016/01/04/unifying-picamera-and-cv2-videocapture-into-a-single-class-with-opencv/)**, making all video processing and examples on the PyImageSearch blog capable of running on both USB and Pi camera setups without having to modify a single line of code.

And just to weeks ago, we discussed how keypoint detection, local invariant descriptors, keypoint matching, and homography matrix estimation can be used to **construct panoramas and stitch images together (https://pyimagesearch.com/2016/01/11/opencv-panorama-stitching/)**.

Today we are going to link together the past 1.5 months worth of posts and use them to perform **real-time panorama and image stitching (https://pyimagesearch.com/2016/01/11/opencv-panorama-stitching/)** using Python and OpenCV. Our solution will be able to run on both laptop/desktops systems, along with the Raspberry Pi.

Furthermore, we'll also apply our *basic motion detection* implementation from last week's post (https://pyimagesearch.com/2016/01/18/multiple-cameras-with-the-raspberry-pi-and-opencv/) to perform motion detection on the panorama image.

This solution is especially useful in situations where you want to survey a wide area for motion, but don't want "blind spots" in your camera view.

Looking for the source code to this post?

JUMP RIGHT TO THE DOWNLOADS SECTION →

Keep reading to learn more...

Real-time panorama and image stitching with OpenCV

As I mentioned in the introduction to this post, we'll be linking together concepts we have learned in the previous 1.5 months of PyImageSearch posts and:

1. Use our improved FPS processing rate Python classes to access our builtin/USB webcams and/or the Raspberry Pi camera module.
2. Access *multiple* camera streams at once.
3. Apply image stitching and panorama construction to the frames from these video streams.
4. Perform motion detection in the panorama image.

Again, the benefit of performing motion detection in the *panorama image* versus *two separate frames* is that we won't have any "blind spots" in our field of view.

Hardware setup

For this project, I'll be using my Raspberry Pi 2, although you could certainly use your laptop or desktop system instead. I simply went with the Pi 2 for it's small form factor and ease of maneuvering in space constrained places.

I'll also be using my **Logitech C920 webcam (http://www.amazon.com/gp/product/B006JH8T3S/ref=as_li_tl?ie=UTF8&camp=1789&creative=390957&creativeASIN=B006JH8T3S&linkCode=as2&tag=trndingcom-20&linkId=BWJJLCCXZCBM465P)** (that is plug-and-play compatible with the Raspberry Pi) along with the **Raspberry Pi camera module (http://www.amazon.com/gp/product/B00E1GGE40/ref=as_li_tl?ie=UTF8&camp=1789&creative=390957&creativeASIN=B00E1GGE40&linkCode=as2&tag=trndingcom-20&linkId=XF5KMO3TGBUENU5T)**. Again, if you decide to use your laptop/desktop system, you can simply hook-up multiple webcams to your machine — the same concepts discussed in this post still apply.

Below you can see my setup:

(https://pyimagesearch.com/wp-content/uploads/2016/01/realtime_panorama_setup_02.jpg)

Figure 1: My the Raspberry Pi 2 + USB webcam + Pi camera module setup.

Here is another angle looking up at the setup:

(https://pyimagesearch.com/wp-content/uploads/2016/01/realtime_panorama_setup_03.jpg)

Figure 2: Placing my setup on top of a bookcase so it has a good viewing angle of my apartment.

The setup is pointing towards my front door, kitchen, and hallway, giving me a full view of what's

The setup is pointing towards my front door, kitchen, and hallway, giving me a full view of what's going on inside my apartment:

(https://pyimagesearch.com/wp-content/uploads/2016/01/realtime_panorama_setup_01.jpg)

Figure 3: Getting ready for real-time panorama construction.

The goal is to take frames captured from both my video streams, stitch them together, and then perform motion detection in the panorama image.

Constructing a panorama, rather than **using multiple cameras and performing motion detection independently in each stream (https://pyimagesearch.com/2016/01/18/multiple-cameras-with-the-raspberry-pi-and-opencv/)** ensures that I don't have any "blind spots" in my field of view.

Project structure

Before we get started, let's look at our project structure:

```
Real-time panorama and image stitching with OpenCV
|--- pyimagesearch
|    |---- __init__.py
|    |--- basicmotiondetector.py
|    |--- panorama.py
|--- realtime_stitching.py
```

As you can see, we have defined a `pyimagesearch` module for organizational purposes. We then have the `basicmotiondetector.py` implementation from last week's post on **accessing multiple cameras with Python and OpenCV (https://pyimagesearch.com/2016/01/18/multiple-**

multiple cameras with Python and OpenCV (https://pyimagesearch.com/2016/01/18/multiple-cameras-with-the-raspberry-pi-and-opencv/)**. This class hasn't changed at all, so we *won't* be reviewing the implementation in this post. For a thorough review of the basic motion detector, be sure to read **last week's post (https://pyimagesearch.com/2016/01/18/multiple-cameras-with-the-raspberry-pi-and-opencv/)**.

We then have our `panorama.py` file which defines the `Stitcher` class used to stitch images together. We initially used this class in the **OpenCV panorama stitching tutorial (https://pyimagesearch.com/2016/01/11/opencv-panorama-stitching/)**.

However, as we'll see later in this post, I have made a *slight* modifications to the constructor and `stitch` methods to facilitate real-time panorama construction — we'll learn more about these slight modifications later in this post.

Finally, the `realtime_stitching.py` file is our main Python driver script that will access the multiple video streams (in an efficient, threaded manner of course), stitch the frames together, and then perform motion detection on the panorama image.

Updating the image stitcher

In order to (1) create a real-time image stitcher and (2) perform motion detection on the panorama image, we'll assume that both cameras are *fixed* and *non-moving*, like in **Figure 1** above.

Why is the fixed and non-moving assumption so important?

Well, remember back to our lesson on **panorama and image stitching (https://pyimagesearch.com/2016/01/11/opencv-panorama-stitching/)**.

Performing keypoint detection, local invariant description, keypoint matching, and homography estimation is a *computationally expensive* task. If we were to use our previous implementation, we would have to perform stitching on *each* set of frames, making it near impossible to run in real-time (especially for resource constrained hardware such as the Raspberry Pi).

However, if we assume that the cameras are fixed, ***we only have to perform the homography matrix estimation once!***

After the initial homography estimation, we can use the same matrix to transform and warp the images to construct the final panorama — doing this enables us to skip the computationally expensive steps of keypoint detection, local invariant feature extraction, and keypoint matching in each set of frames.

Below I have provided the relevant updates to the `Sticher` class to facilitate a cached homography matrix:

```
    Real-time panorama and image stitching with OpenCV
1.  # import the necessary packages
```

```
2. import numpy as np
3. import imutils
4. import cv2
5.
6. class Stitcher:
7.    def __init__(self):
8.        # determine if we are using OpenCV v3.X and initialize the
9.        # cached homography matrix
10.       self.isv3 = imutils.is_cv3()
11.       self.cachedH = None
```

The only addition here is on **Line 11** were I define `cachedH`, the cached homography matrix.

We also need to update the `stitch` method to cache the homography matrix after it is computed:

```
    Real-time panorama and image stitching with OpenCV
13.    def stitch(self, images, ratio=0.75, reprojThresh=4.0):
14.        # unpack the images
15.        (imageB, imageA) = images
16.
17.        # if the cached homography matrix is None, then we need to
18.        # apply keypoint matching to construct it
19.        if self.cachedH is None:
20.            # detect keypoints and extract
21.            (kpsA, featuresA) = self.detectAndDescribe(imageA)
22.            (kpsB, featuresB) = self.detectAndDescribe(imageB)
23.
24.            # match features between the two images
25.            M = self.matchKeypoints(kpsA, kpsB,
26.                featuresA, featuresB, ratio, reprojThresh)
27.
28.            # if the match is None, then there aren't enough matched
29.            # keypoints to create a panorama
30.            if M is None:
31.                return None
32.
33.            # cache the homography matrix
34.            self.cachedH = M[1]
35.
36.        # apply a perspective transform to stitch the images together
37.        # using the cached homography matrix
38.        result = cv2.warpPerspective(imageA, self.cachedH,
39.            (imageA.shape[1] + imageB.shape[1], imageA.shape[0]))
40.        result[0:imageB.shape[0], 0:imageB.shape[1]] = imageB
41.
42.        # return the stitched image
43.        return result
```

On **Line 19** we make a check to see if the homography matrix has been computed before. If not, we detect keypoints and extract local invariant descriptors from the two images, followed by applying keypoint matching. We then cache the homography matrix on **Line 34**.

Subsequent calls to `stitch` will use this cached matrix, allowing us to sidestep detecting keypoints, extracting features, and performing keypoint matching on *every* set of frames.

For the rest of the source code to `panorama.py`, please see the **image stitching tutorial (https://pyimagesearch.com/2016/01/11/opencv-panorama-stitching/)** or use the form at the bottom of this post to download the source code.

Performing real-time panorama stitching

Now that our `Stitcher` class has been updated, let's move on to to the `realtime_stitching.py` driver script:

Real-time panorama and image stitching with OpenCV

```
1. # import the necessary packages
2. from __future__ import print_function
3. from pyimagesearch.basicmotiondetector import BasicMotionDetector
4. from pyimagesearch.panorama import Stitcher
5. from imutils.video import VideoStream
6. import numpy as np
7. import datetime
8. import imutils
9. import time
10. import cv2
11.
12. # initialize the video streams and allow them to warmup
13. print("[INFO] starting cameras...")
14. leftStream = VideoStream(src=0).start()
15. rightStream = VideoStream(usePiCamera=True).start()
16. time.sleep(2.0)
```

We start off by importing our required Python packages. The `BasicMotionDetector` and `Stitcher` classes are imported from the `pyimagesearch` module. We'll also need the `VideoStream` class from the **imutils (https://github.com/jrosebr1/imutils)** package.

If you don't already have `imutils` installed on your system, you can install it using:

Real-time panorama and image stitching with OpenCV

```
1. $ pip install imutils
```

If you do already have it installed, make sure you have upgraded to the latest version (which has added Python 3 support to the `video` sub-module):

Real-time panorama and image stitching with OpenCV

```
1. $ pip install --upgrade imutils
```

Lines 14 and 15 then initialize our two `VideoStream` classes. Here I assume that `leftStream` is a USB camera and `rightStream` is a Raspberry Pi camera (indicated by `usePiCamera=True`).

If you wanted to use *two USB cameras*, you would simply have to update the stream initializations to:

Real-time panorama and image stitching with OpenCV

```
1. leftStream = VideoStream(src=0).start()
2. rightStream = VideoStream(src=1).start()
```

The `src` parameter controls the *index* of the camera on your system.
Again, it's ***imperative*** that you initialize `leftStream` and `rightStream` correctly. When standing *behind* the cameras, the `leftStream` should be the camera to your lefthand side and the `rightStream` should be the camera to your righthand side.

Failure to set these stream variables correctly will result in a "panorama" that contains only *one* of the *two* frames.

From here, let's initialize the image stitcher and motion detector:

```
Real-time panorama and image stitching with OpenCV
18. # initialize the image stitcher, motion detector, and total
19. # number of frames read
20. stitcher = Stitcher()
21. motion = BasicMotionDetector(minArea=500)
22. total = 0
```

Now we come to the main loop of our driver script where we loop over frames infinitely until instructed to exit the program:

```
Real-time panorama and image stitching with OpenCV
24. # loop over frames from the video streams
25. while True:
26.     # grab the frames from their respective video streams
27.     left = leftStream.read()
28.     right = rightStream.read()
29.
30.     # resize the frames
31.     left = imutils.resize(left, width=400)
32.     right = imutils.resize(right, width=400)
33.
34.     # stitch the frames together to form the panorama
35.     # IMPORTANT: you might have to change this line of code
36.     # depending on how your cameras are oriented; frames
37.     # should be supplied in left-to-right order
38.     result = stitcher.stitch([left, right])
39.
40.     # no homograpy could be computed
41.     if result is None:
42.         print("[INFO] homography could not be computed")
43.         break
44.
45.     # convert the panorama to grayscale, blur it slightly, update
46.     # the motion detector
47.     gray = cv2.cvtColor(result, cv2.COLOR_BGR2GRAY)
48.     gray = cv2.GaussianBlur(gray, (21, 21), 0)
49.     locs = motion.update(gray)
```

Lines 27 and 28 read the `left` and `right` frames from their respective video streams. We then resize the frames to have a width of 400 pixels, followed by stitching them together to form the panorama. Remember, frames supplied to the `stitch` method need to be supplied in *left-to-right order!*

In the case that the images cannot be stitched (i.e., a homography matrix could not be computed), we break from the loop (**Lines 41-43**).

Provided that the panorama could be constructed, we then process it by converting it to grayscale and blurring it slightly (**Lines 47 and 48**). The processed panorama is then passed into the motion detector (**Line 49**).

However, before we can detect any motion, we first need to allow the motion detector to "run" for a bit to obtain an accurate running average of the background model:

```
Real-time panorama and image stitching with OpenCV
    # only process the panorama for motion if a nice average has
    # been built up
    if total > 32 and len(locs) > 0:
        # initialize the minimum and maximum (x, y)-coordinates,
        # respectively
        (minX, minY) = (np.inf, np.inf)
        (maxX, maxY) = (-np.inf, -np.inf)

        # loop over the locations of motion and accumulate the
        # minimum and maximum locations of the bounding boxes
        for l in locs:
            (x, y, w, h) = cv2.boundingRect(l)
            (minX, maxX) = (min(minX, x), max(maxX, x + w))
            (minY, maxY) = (min(minY, y), max(maxY, y + h))

        # draw the bounding box
        cv2.rectangle(result, (minX, minY), (maxX, maxY),
            (0, 0, 255), 3)
```

We use the first 32 frames of the initial video streams as an estimation of the background — during these 32 frames *no* motion should be taking place.

Otherwise, provided that we have processed the 32 initial frames for the background model initialization, we can check the `len` of `locs` to see if it is greater than zero. If it is, then we can assume "motion" is taking place in the panorama image.

We then initialize the minimum and maximum *(x, y)*-coordinates associated with the locations containing motion. Given this list (i.e., `locs`), we loop over the contour regions individually, compute the bounding box, and determine the smallest region encompassing all contours. This bounding box is then drawn on the panorama image.

As mentioned in **last week's post (https://pyimagesearch.com/2016/01/18/multiple-cameras-with-the-raspberry-pi-and-opencv/)**, the motion detector we use assumes there is only *one* object/person moving at a time. For *multiple objects*, a more advanced algorithm is required (which we will cover in a future PyImageSearch post).

Finally, the last step is to draw the timestamp on panorama and show the output images:

```
Real-time panorama and image stitching with OpenCV
    # increment the total number of frames read and draw the
    # timestamp on the image
    total += 1
    timestamp = datetime.datetime.now()
    ts = timestamp.strftime("%A %d %B %Y %I:%M:%S%p")
    cv2.putText(result, ts, (10, result.shape[0] - 10),
        cv2.FONT_HERSHEY_SIMPLEX, 0.35, (0, 0, 255), 1)

    # show the output images
    cv2.imshow("Result", result)
    cv2.imshow("Left Frame", left)
    cv2.imshow("Right Frame", right)
    key = cv2.waitKey(1) & 0xFF
```

```
84.     # if the `q` key was pressed, break from the loop
85.     if key == ord("q"):
86.         break
87.
88. # do a bit of cleanup
89. print("[INFO] cleaning up...")
90. cv2.destroyAllWindows()
91. leftStream.stop()
92. rightStream.stop()
```

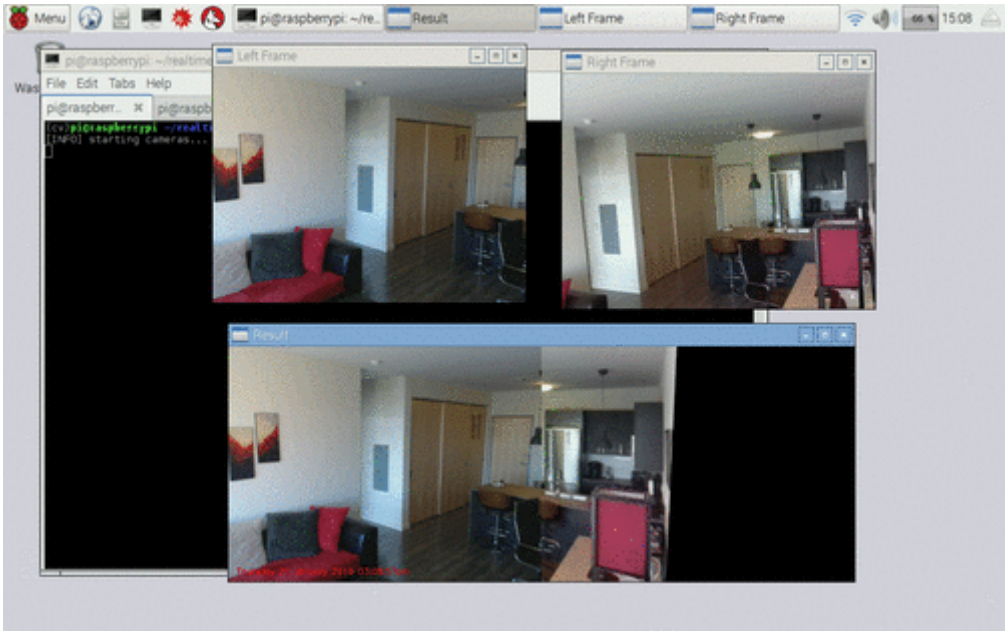
Lines 82-86 make a check to see if the `q` key is pressed. If it is, we break from the video stream loop and do a bit of cleanup.

Running our panorama builder + motion detector

To execute our script, just issue the following command:

```
Real-time panorama and image stitching with OpenCV
1. $ python realtime_stitching.py
```

Below you can find an example GIF of my results:



(https://pyimagesearch.com/wp-content/uploads/2016/01/realtime_panorama_stitching_animation.gif)

Figure 4: Applying motion detection on a panorama constructed from multiple cameras on the Raspberry Pi, using Python + OpenCV.

On the *top-left* we have the **left video stream**. And on the *top-right* we have the **right video stream**. **On the *bottom*, we can see that both frames have been stitched together into a single panorama.** Motion detection is then performed on the panorama image and a bounding box drawn around the motion region.

The full video demo can be seen below:

Summary

In this blog post, we combined our knowledge over the past 1.5 months of tutorials and:

1. Increased FPS processing rate using threadng.
2. Accessed *multiple* video streams at once.
3. Performed image stitching and panorama construction from these video streams.
4. And applied motion detection on the panorama image.

Overall, we were able to easily accomplish all of this on the Raspberry Pi. We can expect *even faster* performance on a modern laptop or desktop system.

See you next week!

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About the Author

About the Author

Hi there, I'm Adrian Rosebrock, PhD. All too often I see developers, students, and researchers wasting their time, studying the wrong things, and generally struggling to get started with Computer Vision, Deep Learning, and OpenCV. I created this website to show you what I believe is the best possible way to get your start.

Previous Article:

Multiple cameras with the Raspberry Pi and OpenCV

(https://www.pyimagesearch.com/2016/01/18/multiple-cameras-with-the-raspberry-pi-and-opencv/)

Next Article:

OpenCV center of contour

(https://www.pyimagesearch.com/2016/02/01/opencv-center-of-contour/)

111 responses to: Real-time panorama and image stitching with OpenCV

Sarath

January 25, 2016 at 11:22 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387936)

Good Work !
When looking at the video, i feel like your Pi works faster than mine... At what clock frequency you are running your Pi?

Reply

Adrian Rosebrock

January 25, 2016 at 4:05 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387983)

I am using the stock clock frequency, no overclocking is being performed.

Reply

anish

January 25, 2016 at 1:42 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387957)

You rock man … Supb tuto.

Reply

Adrian Rosebrock

January 25, 2016 at 4:03 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387980)

Thanks so much!

Reply

Joe

February 5, 2020 at 2:48 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-703967)

I just came across this doing some research on a little project I'd like to do.
I'm self taught using Internet resources and am still learning python and just delving into opencv.
I read your very well written post and was curious about something. In my case, I don't want to use motion detection, I simply want to stitch 2 back to back rpi camera streams together to create a 360 stream. Would this be possible of the back of this tutorial with a bit of modification?
I read the assumption that both cameras are fixed and non moving, in my case, the cameras are fixed back to back and will not move but I intend for the cameras to be mobile to stream video with.
Would this be possible?

Reply

Hemant Sharma

January 25, 2016 at 1:45 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387958)

Doing a great job for beginners like me,
Keep going.....

Reply

Adrian Rosebrock

January 25, 2016 at 4:03 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387979)

Thanks Hemant!

Reply

Max

January 25, 2016 at 2:20 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387961)

Hi Adrian,
Been following your blog for a while, great work man, great work! and it tends to get more impressive from post to post 😀 wonder how long you can keep up that pace 🙂 and i Luke your case studies.
Cheers
Max

Reply

Adrian Rosebrock

January 25, 2016 at 4:03 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387978)

Thanks for the kind words Max! 🙂

Reply

Scott

January 25, 2016 at 2:41 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and

January 25, 2016 at 2:41 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-387967)

Nice to see your new project! Terrific!

Reply

Flo

January 26, 2016 at 8:54 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-388073)

A nice addition would be to give the stitcher the same interface as a videostream.
The stitching could be run in its own thread (like the cams do), but more importantly the motion detector (for example) could just take a videostream instead and do its thing.

So you would end up with:
motion = BasicMotionDetector(aVideoStream, minArea=500)
and in the loop:
motion.update()

That way you have a 'larger videostream' and the code doesn't have to care where the images come from.

Reply

Adrian Rosebrock

January 26, 2016 at 5:54 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-388122)

After the initial homography estimation, all that needs to be done to stitch images together is used `cv2.warpPerspective` which runs quite fast. Realistically, I don't think threading would improve performance that much in this case.

Reply

Flo

February 1, 2016 at 4:24 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-388671)

Threading was just a side-note.

I really liked the idea though to be able to use the stitcher just like a “normal” pi/web cam VideoStream (basically have something like a (java) interface) and use that interchangably in other code.

Reply

Helios

February 19, 2016 at 5:13 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-390484)

Hi Adrian

I want to stitch two videos i have. How would I go about doing that using the same code.
Just some pointers in the right direction would be appreciated.

Reply

Adrian Rosebrock

February 19, 2016 at 6:51 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-390491)

If you have two videos, then you’ll need to read frames from both of them using the `cv2.VideoCapture` function. Once you have both the frames, you can apply the stitching code. If you’re interesting, I cover how to use `cv2.VideoCapture` in a variety of applications inside **Practical Python and OpenCV (https://www.pyimagesearch.com/practical-python-opencv/)**.

Reply

sarath

March 7, 2016 at 9:07 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-391536)

Hi, Adrian

I have pi camera and a web camera, i tried to stitch videos from two camera, i get no homograpy could be computed. i am placing two camera’s exactly on the same line, the thing is my web

camera focus is slightly zoomed than the pi camera, will that be an issue?

Reply

Adrian Rosebrock

March 7, 2016 at 4:09 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-391544)

If you're getting an error that the homography cannot be computed, then there are not enough raw keypoint matches. Make sure you are detecting a sufficient number of reliable keypoints. You might have to play with different keypoint detectors as well. Otherwise, it's hard to say if the zooming issue would be a problem without seeing your actual images. As I said, this issue can likely be resolved by ensuring enough reliable keypoints are being detected in both images.

Reply

jimmy

August 17, 2016 at 2:16 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-404474)

Hi,Adrian

I copy your code to my raspberry pi ,but it didn't work ! (I also use picamera and USB webcam). When I execute the "realtime_stitching.py" ,it just show that [INFO] starting cameras... and nothing happen.
I don't know how to fix this problem....can you help me?

Reply

Adrian Rosebrock

August 17, 2016 at 12:01 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-404489)

See my reply to "Sarath" above. It seems likely that the homography matrix isn't being computed. Otherwise, if you are getting no video streams displayed to your screen, then you'll need to double-check that your machine can properly access the cameras.

Reply

Alborz

September 1, 2016 at 4:39 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-405311)

Hi, Great post.

I was wondering, you are assuming fixed camera positions, what would happen if you were to apply the homography estimation continuously (lets say the cameras were moving).

I know that this is a computationally expensive task but lets assume we are not using a Raspberry Pi.

Would it be possible to use the same code (modified version) to stitch multiple moving cameras?

(I am also looking at this code which takes another approach **https://www.youtube.com/watch?v=mMcrOpVx9aY (https://www.youtube.com/watch?v=mMcrOpVx9aY)**)

Just t clarify, by “moving cameras” , I still mean that cameras do not move relative to each other. But lets say they were mounted on sides of a car.

Reply

Adrian Rosebrock

September 1, 2016 at 10:58 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-405329)

Providing your system is fast enough, there shouldn’t be an issue applying homography estimation continuously. The only problem you might encounter is if there is too much “jitter” and “noise” in your video stream, causing the homography estimation to change. If the homography estimation changes, so does your resulting panorama.

Reply

Sven (http://www.vfxbox.de)

September 2, 2016 at 3:34 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-405372)

What kind of pc would be needed to stitch 6 camera streams (Blackmagic) into one 360 video in realtime?

Would it work with OpenCV?

Reply

Adrian Rosebrock

September 2, 2016 at 6:57 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-405378)

If your homography matrices are pre-computed (meaning they don't need to be re-computed and re-validated) between each set of frames, you can actually perform image stitching on low end hardware (like a Raspberry Pi). If you need to constantly re-compute the matrices though, you will likely need a standard laptop/desktop system. I've never personally worked with stitching frames into a full 360 panorama though, so that question would likely need more investigation and even a bit of experimentation.

Reply

Stijn

January 9, 2019 at 5:23 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-495313)

Hi Sven,

Did you manage to do this? Any code you could share? I'm looking into doing the same for 4 camera's.

Thanks.

Reply

Sevastsyan

September 28, 2016 at 6:52 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-406899)

Hello, Adrian.
I have two usb webcams and trying to get panoramic video, but one of my frames(right frame always) got damaged after stitching. I'l try to change cams, but it steal the same problem. Maybe you know how to fix it?

Reply

Adrian Rosebrock

September 28, 2016 at 10:34 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-406924)

Hm, nothing comes to mind off the top of my head. Without seeing your setup it's pretty much impossible to tell what the exact issue is. My guess is that the quality of keypoints being matched is very low leading to a poor homography matrix.

Reply

Sevastsyan

September 29, 2016 at 3:45 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-407021)

What version of python and openCV did you use?

Reply

Adrian Rosebrock

September 30, 2016 at 6:44 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-407106)

I used both Python 2.7 and Python 3 along with OpenCV 2.4 and OpenCV 3. The code should be compatible with all versions.

Reply

Manoj

February 21, 2019 at 6:15 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-502683)

Hello,Sevastsyan.

have figured out a solution to this problem ,if so please share your knowledge.

Reply

Ken

September 28, 2016 at 2:12 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-406951)

I'm trying to figure out how to apply this to more than two cameras (five, actually, in a 360 degree panorama). I did see that the case of a >2 camera panorama was mentioned here somewhere as a case that might be covered in the future.

Has it been covered yet? If so I don't see it.

Thanks!

Reply

Adrian Rosebrock

September 30, 2016 at 6:50 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-407112)

I haven't had a chance to cover image stitching for > 2 images yet. It's in my queue but I'm honestly not sure when I'll be able to write about it.

Reply

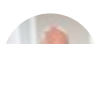
Per-Inge

October 31, 2016 at 4:49 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-409449)

Hi Adrian! Nice guide!

I would need to stitch two cameras on top of each other, like top and bottom instead of left and right.
What would I need to edit in the code to make this to happen?

Reply



Adrian Rosebrock

November 1, 2016 at 9:03 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-409543)

Thanks, I'm glad you enjoyed the guide. As for stitching images on top of each other, you need to change **Lines 38-40** The first change is `cv2.warpPerspective` so that your output image is tall than it is wide (as the current code does). Then, you can update **Line 40** to stack the images vertically rather than horizontally by adjusting the NumPy array slice. I hope that helps!

Reply

Rakshit

November 21, 2016 at 3:34 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-411326)

Hi Adrian, Awesome guide..

1. I would need to save the stitched video stream on to a file. I used the cv2.Videowriter function shown in this guide of yours- **https://www.pyimagesearch.com/2016/02/22/writing-to-video-with-opencv/ (https://www.pyimagesearch.com/2016/02/22/writing-to-video-with-opencv/)** . But the output file is rather empty. Is there any specific modification for this?

2. I would also like to know if it is possible to stitch the image for more than two usb cameras?

Thanks

Reply

Adrian Rosebrock

November 22, 2016 at 12:40 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-411433)

Writing video to file with OpenCV is unfortunately a pain in in the ass. The issue could be a lot of things related to logic in your code, how your system is configured, the list goes on. I would suggest taking a step back and just trying to write frames from your video stream to file *without* any processing. This will at least tell you if the problem is with your system or your code.

As for stitching together more than two frames, I will try to cover that in a future blog post.

Reply

BruceJ (http://www.synovision.com)

November 21, 2016 at 4:06 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-411330)

Adrian, am looking at trying to stitch more than 2 videos together to make a wide panorama file (multiple HDMI woven into one wide window) from which I can select a viewing window (single HDMI window). Really like your subject following. One idea would be to keep the display window (single HDMI) centered around the moving subject but keep all the background which doesn't change much as context. Do you think this is a difficult extension to what you've done?
Second question has to do with computing. If I know that the background and cameras are not going to move, then the only data i need to deal with is that related to the subject (that which is different from the standard background). Could/should this be done by using one RP to extract the subject from the background (large fixed file?) and then another to manage the tracking and other functions?
Really impressive what you've done!

Reply

Adrian Rosebrock

November 22, 2016 at 12:38 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-411432)

Hey Bruce — this sounds like a simple object tracking problem. Once you have the object detected you can track it as it moves around (and extract its ROI and background for context). If your cameras are fixed and not moving, this process becomes even easier. Please see **this post (https://www.pyimagesearch.com/2015/03/30/accessing-the-raspberry-pi-camera-with-opencv-and-python/)** for more details on a simple motion detector and tracker.

Reply

BruceJ

November 23, 2016 at 6:44 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-411554)

Adrian, thanks for the tip. I'm working through it all now. is it possible to test some of this using a windows computer rather than the Pi? I only ask this because the Pi, which I have a 3 and camera, is a bit more physically difficult to deal with than, say, getting it all to work using a web cam and monitor that is already connected?

I'll be buying your book, too!
Thanks, again.

Reply

Adrian Rosebrock
November 24, 2016 at 9:38 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-411621)

Absolutely! As long as you use my `VideoStream` class you should be able to easily develop on Windows and deploy to the Raspberry Pi with minimal code changes.

Reply

BruceJ
November 25, 2016 at 10:02 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-411752)

Adrian, thanks, again! You've hooked me. I'm just starting in computer vision, so, I'm heading to "Start Here." You are an excellent teacher and communicator. I'll be spending a good bit of time here!

Reply

Adrian Rosebrock
November 28, 2016 at 10:39 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-412020)

Fantastic, glad to hear it! I hope the "Start Here" guide helps you on your journey!

Reply

Jeff Cicolani
December 13, 2016 at 11:17 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-413462)

Loving this blog. It's really helping me learn computer vision quickly

Loving this blog! It's really helping me learn computer vision quickly.

Question, though…

How would one determine the amount of overlap between the two images? I need to determine the center of the overlapped space.

Reply

Adrian Rosebrock

December 14, 2016 at 8:27 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-413493)

I'm glad you're finding the blog helpful Jeff, that's great!

As for determining the level of overlap, there are multiple ways to do this. I would suggest looking at the (x, y)-coordinates of your *matched* keypoints in both images. Matched keypoints indicate overlap. Based on these coordinates you can derive the ratio of overlap between the two images.

Reply

Al

December 22, 2016 at 2:31 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-414026)

Hi, very nice tutorial.
I want to take this one step further.
I want to use 3 goPros, a HDMI capture card to stitch real-time video.
How should I start to modify your code? and what is important to think about?

Reply

Adrian Rosebrock

December 23, 2016 at 10:56 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-414131)

Using more than 2 cameras becomes much *more* challenging, the reasons of which are many for a blog post comment. I've been wanting to do a blog post on the topic, but haven't gotten around to it. I will try to do one soon!

Reply

David (http://davidlary.info)

December 29, 2016 at 2:11 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-414653)

Great work Adrian, what is the maximum number of video streams that can be combined?

I was thinking of a set up using the NVIDIA Jetson and 6 cameras **http://www.nvidia.com/object/jetson-tx1-dev-kit.html (http://www.nvidia.com/object/jetson-tx1-dev-kit.html)** and **https://www.e-consystems.com/blog/camera/?p=1709 (https://www.e-consystems.com/blog/camera/?p=1709)**

Reply

Adrian Rosebrock

December 31, 2016 at 1:22 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-414820)

I haven't tried with more than 4 cameras before. But in theory, 6 shouldn't be an issue, although the stitching algorithm will need to be updated to handle this.

Reply

Ashwin

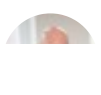
January 22, 2017 at 12:57 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-416245)

Hi Adrain,

I tried to use your code on Raspberry Pi 3 using 2 cameras but I get "Segmentation failed" error on the command window.

Can you please suggest me how to fix this error.

Reply



Adrian Rosebrock

January 24, 2017 at 2:32 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-416398)

Can you run a traceback error to determine which line of code caused the error? Also, which version of OpenCV are you using?

Reply

Judy

January 31, 2017 at 10:29 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-416865)

Would there be any way to get this feed to stream to something like a VR device? Like would it be compatible with ffmpeg or something similar?

Reply

Judy

February 3, 2017 at 3:18 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-417032)

Also, would it be possible to stitch something coming from a uv4l mjpeg stream?

Reply

Adrian Rosebrock

February 4, 2017 at 9:25 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-417059)

Yes, absolutely. Provided you can read the frame(s) from a video stream the exact same process applies. You would just need to code the logic to grab the frame from your respective frames.

Reply

Daniella Solomon

February 8, 2017 at 9:17 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-417275)

Hi, i tried to run this code on ip cameras, but it's not working- I changed VideoStream function to cv2.VideoCapture,
is there some information about VideoStream ?
my goal is to run both streams using threading

Reply

Judy

March 8, 2017 at 11:19 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-419736)

I'd like to learn more of this as well, as I'm working with this stuff right now. I cannot find any documentation on VideoStream() for OpenCV

Reply

Mathew Orman (http://innovation.ag)

March 16, 2017 at 10:17 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-420483)

stitcher.stitch() exits the script without any messages
Any ideas?

Reply

Adrian Rosebrock

March 17, 2017 at 6:40 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-420547)

Can you elaborate more on what you mean by "exits the script without any messages"? Normal issues would be not being able to access both video streams, thus the stitching not being able to take place. Otherwise, depending on OpenCV version, you might see a seg-fault based on which keypoint detector + descriptor you are using.

Reply

Mathew Orman (http://innovation.ag)

March 16, 2017 at 11:12 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-420487)

I am using Python v. 2.7 and cv2 v. 2.4.9.1

Reply

Mathew Orman (http://innovation.ag)

March 17, 2017 at 4:42 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-420538)

So, you've deleted my comments and questions?

Reply

Adrian Rosebrock

March 17, 2017 at 6:41 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-420548)

Hey Matthew:

Due to spam reasons, all comments have to be manually approved by me on the PyImageSearch blog. After a comment is entered, it goes into the database, and awaits moderation. — your comments were not deleted, just waiting for approval.

I normally go through comments every 72 hours or so (I can't spend all my time waiting for new comments to enter the queue).

I will approve + reply to your comments when I can, but please be patient and please don't expect the worst and that I would delete your comments. Thank you.

Reply

Daniella Solomon

April 27, 2017 at 3:13 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-423883)

Hi,

As I understand the homography matrix is M[1], am I right?
How can I use her for another transform that I'm trying to do.
I want to multiple a pixel (x1,y1,1) in one image and to get the result on the second image (x2,y2,1) I tried to do it, but it doesn't work – maybe can you help me with it?
Thanks in advance.
Daniella

Reply

Jay (http://pixel-studio.dk)

May 15, 2017 at 5:36 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-425271)

Hi,

I keep getting this error when trying to launch the script.

Traceback (most recent call last):
File "realtime_stitching.py", line 3, in
from pyimagesearch.basicmotiondetector import BasicMotionDetector
ImportError: No module named pyimagesearch.basicmotiondetector

I have brought your book and have you image installed on my Rasberry Pi.

Can you please help me

Reply

Adrian Rosebrock

May 17, 2017 at 10:05 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-425416)

Hi Jay — make sure you use the “Downloads” section of this blog post to download the source code. This will provide you with code that has the exact same directory structure as mine. It’s likely that your directory structure is incorrect. Download my source code and compare it to mine and I’m positive that you’ll be able to spot the differences.

Reply

Samer

May 23, 2017 at 8:35 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-425864)

Hi,
I am working on a project, I want to make a panoramic map off of a live footage of a camera, the camera traverses in a room (via car/drone) in a specific high, and it will only see the floor.
Do you have a suggestion on how and where should I learn to do this? I am working with OpenCV by the way.
OH and great job.

Reply

Adrian Rosebrock

May 25, 2017 at 4:28 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-425970)

Hi Samer — so if I understand your question correctly, your camera only has a view of the floor? And you want to create a map of the room this way?

Reply

Giannis

May 31, 2017 at 5:29 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-426400)

Hi Adrian,
I love your blog! I started reading as a hobby and now i want to test everything! Really great work – thank you so much!
I have a question about the panoramic stitching. With minor changes to your code i tried to read

from 2 video files as an input and created a stitched result which is shown on its own frame, same as your example.
I can see the resulted stitched video and it is correct but i cannot save it to file. It creates a file but with only 6KB size.
Maybe a codec problem?
(Tried many codecs, even set value to -1 in order to choose. Also tried different syntax for codec – MJPG, 'M','J','P','G' etc.)
Any tip to put me to the right path?
Windows 8.1 , Python 3.6, OpenCV 3

Once again great job! Thank you in advance

Reply

Adrian Rosebrock

May 31, 2017 at 1:01 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-426423)

Hi Giannis — unfortunately writing to video with OpenCV is a bit of a pain. I **wrote a blog post on it (https://www.pyimagesearch.com/2016/02/22/writing-to-video-with-opencv/)**, I hope it can help you!

Reply

Giannis

June 1, 2017 at 1:07 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-426530)

I read it before attempting the recording but i thought to ask here also ☺
I will try again though and report back with any findings If i manage to record it successfully.
Thank you again for your kind help!

Reply

Daniel

June 17, 2017 at 4:15 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-427579)

Is it possible to use those functions in OpenCV Stitcher class (eg. blender and exposureCompensator) to improve the panorama, like eliminate the seam at the middle?

exposureCompensator) to improve the panorama, like eliminate the seam at the middle?

Reply

Changlong Di

June 27, 2017 at 1:31 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-428189)

Thank you so much!

Reply

Binks

July 13, 2017 at 9:00 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-429810)

Hi Adrian,

I will be attempting to connect four cameras like that:

https://www.aliexpress.com/store/product/1080p-full-hd-mjpeg-30fps-60fps-120fps-OV2710-cmos-usb-camera-for-android-linux-raspberry-pi/913995_32397903999.html?spm=2114.10010108.1000023.1.34tJER (https://www.aliexpress.com/store/product/1080p-full-hd-mjpeg-30fps-60fps-120fps-OV2710-cmos-usb-camera-for-android-linux-raspberry-pi/913995_32397903999.html?spm=2114.10010108.1000023.1.34tJER)

Do you think it would be straightforward, or are there any possible challenges with ordering cameras from aliexpress? Maybe you have a good suggestion what hardware would be the best?

Thanks!

Reply

Adrian Rosebrock

July 14, 2017 at 7:20 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-429838)

I have never used the camera you linked to. I've normally use the Logitech C920 with my Raspberry Pi. Regardless of the camera model you choose, keep in mind that the Pi likely will not

Raspberry Pi. Regardless of the camera model you choose, keep in mind that the Pi likely will not draw enough current to power all four cameras. You'll also likely need a USB hub that can be plugged into a wall for extra power.

Reply

Jerry Kiley

September 16, 2017 at 3:28 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-434986)

I am intrigued by the possibilities of this. I have a motorhome and have looked for a good 360 birdseye view camera system to no avail. It seems it could work with 4 ip fisheye cameras through rtsp. Only a small portion of the corner of each image would have to be maped. Any ideas on what I would have to do to get it done. This would be a great continuation of this post for multiple cameras. Thank you.

Reply

manju

November 14, 2017 at 4:49 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-440571)

matches = self.flann.knnMatch(
^

SyntaxError: invalid syntax

I get above error when i use your above code of image stitching

Reply

Adrian Rosebrock

November 15, 2017 at 1:05 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-440686)

Hi Manju — please make sure you use the "Downloads" section of this guide to download the source code and example videos. This will ensure there are no syntax errors that may happen when copying and pasting code.

Reply

Jose (http://jose.com.co)

April 3, 2018 at 11:13 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-454973)

Hi Adrian, first of all, thanks a lot for your work on helping others. I would like to know if is possible to do this in the background and have the Pi to provide a video stream url that you can grab in a browser, I'm trying to get 4 cameras (360) stitched together in a single feed and then using WebGL build a 360 interface to navigate that feed. Any help is appreciated and again thanks!

Reply

Adrian Rosebrock

April 4, 2018 at 12:11 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-455081)

You can certainly perform this process in the background but I don't have any tutorials on streaming the output straight to a web browser. I will consider this for a future tutorial. Thank you for the suggestion.

Reply

Joseph McRae

June 6, 2018 at 11:12 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-467218)

Mr. Rosebrock,
I emailed you about a year ago to see whether you would be interested in discussing a business opportunity using the video stitching software you described above. I'm still working on the business and would love to re-visit with you the possibility of talking about the project.

In a nutshell, it would involve real-time stitching of feeds from 2 video cameras at a sporting event (your part), then indexing and distributing the resulting video via cloud servers. There is definitely an altruistic component to the project, but also a financial component as well. There appears to be money to be made on this type of project.

I assembled a small team and we have made great progress with the indexing and distribution end of this project. I also have access to sports teams and have obtained permissions to film. Your demonstrated expertise could be very helpful.

I would love to hear back from you to gauge your interest.

Reply

Adrian Rosebrock

June 6, 2018 at 11:46 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-467221)

Hey Joseph, thanks for considering me for the project but to be honest, I have too much on my plate right. Between planning PyImageConf 2018 and planning a wedding on top of that my time is just spread too thin. I would suggest posting the project on **PyImageJobs (https://jobs.pyimagesearch.com/)** and hiring a computer vision developer from there.

Reply

Shalini

August 16, 2018 at 3:59 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-474522)

hey Adrian, love your work. I'm trying to do video stitching with live feed through IP cameras. I'm able to get the feed only by using rtsp command but the stitch is not proper. there is some kind of jerking effect observed.

tried the same using your but then i got an attribute error stating "tuple object has no attribute called shape".

how can i perform video stitching of 2 IP cameras using the code you provided. i mean to say what changes are to be done to access cameras using IP address and then perform video stitch.

Reply

Adrian Rosebrock

August 17, 2018 at 7:26 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-474650)

That jerking effect you are referring to is due to mismatches in the keypoint matching process. You might want to try a different keypoint detector to see if accuracy improves.

Reply

RS

August 16, 2018 at 4:08 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-474523)

Hi Adrian,
Been following your work recently regarding stitching. I am working on similar project, I would want to know how to access IP cameras and perform video stitching.

Please help me.
Thanks in advance.

Reply

Adrian Rosebrock

August 17, 2018 at 7:25 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-474649)

I don't have any tutorials on accessing IP cameras yet, but I hope to cover it in the future! Sorry I couldn't be of more direct help right now.

Reply

Christoph (http://app-studio-trier.de)

January 8, 2019 at 12:27 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-495171)

Hi Adrian,

thanks for your tutorials, they're always a great inspiration.

I'm currently working on stitching a real time panorama from five cameras that will never move relative to one another. I've been following the approach outlined here:

https://kushalvyas.github.io/stitching.html (https://kushalvyas.github.io/stitching.html)

The main idea is to stitch from center to left and then from center to right.

While I have been able to increase speed of aforementioned code by a factor of ~ 300, it still takes me around a quarter of a second to stitch the panorama. Too long to call it real time.

Are you planing to cover real time stitching of > 2 images any time soon? Or do you know of any other quality resources on this topic?

Thanks, Christoph.

Reply

Adrian Rosebrock

January 11, 2019 at 10:00 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-495948)

I wrote a **followup tutorial on image stitching. (https://www.pyimagesearch.com/2018/12/17/image-stitching-with-opencv-and-python/)** I would suggest starting there (and be sure to see my comments on real-time stitching).

Reply

Garmi

January 14, 2019 at 4:25 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-496279)

Hello everyone i need help
I need to develop a video surveillance system that records the video stream in case of motion detection

Reply

Adrian Rosebrock

January 16, 2019 at 9:55 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-496661)

I would suggest starting with **this tutorial. (https://www.pyimagesearch.com/2016/02/29/saving-key-event-video-clips-with-opencv/)** It

(https://www.pyimagesearch.com/2018/02/26/saving-key-event-video-clips-with-opencv/) it will show you how to write key event clips to video file. You can then swap out the color thresholding for motion detection (like we've done here).

Reply

Michael

February 6, 2019 at 3:51 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-500042)

Hi Adriane
With the same your implementation, is it possible to stitch three sources of cameras ?
Because I have a project that almost the same idea of this post implementation but it requires stitching three images instead of two.

Reply

Adrian Rosebrock

February 7, 2019 at 6:58 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-500265)

Take a look at my **latest multi-image stitching tutorial. (https://www.pyimagesearch.com/2018/12/17/image-stitching-with-opencv-and-python/)** Inside the post you'll learn how to stitch multiple images; however, you'll run into a few caveats with real-time stitching.

Reply

Michael

February 11, 2019 at 10:36 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-500823)

Thanks
One more question, is it possible to control the stitch direction? (on this post, the stitched result comes on the right, is it possible to apply the same implementation but the stitched result will

be on the left instead of right?)

Reply

christian

February 12, 2019 at 10:32 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-500954)

Hi, Adrian, a pleasure to greet you.

If I would ike to apply ther motion detector from a streaming of a IP camera, the process would be the same?

Best regards.

Reply

Adrian Rosebrock

February 14, 2019 at 1:16 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-501316)

You would pass in the IP streaming URL to the `src` of the `VideoStream`.

Reply

Christian

February 12, 2019 at 2:26 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-500982)

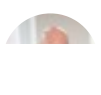
HI Adrian,

How would be the process if I would like to run Yolo detector using streaming from a IP CAMERA?

Can you help me, please.

Thank you, so much.

Reply



Adrian Rosebrock
February 14, 2019 at 1:03 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-501309)

I don't have any tutorials for IP camera streaming but I will try to cover it in a future blog post.

Reply

monika
March 13, 2019 at 7:27 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-506462)

can you share me the code to perform real time image stitching using three cameras?

Reply

Adrian Rosebrock
March 13, 2019 at 3:09 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-506524)

Refer to **this tutorial. (https://www.pyimagesearch.com/2018/12/17/image-stitching-with-opencv-and-python/)**

Reply

Erik Brewster
March 18, 2019 at 2:44 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-507563)

I've done some work based on this code. I like the way you get the homography matrix and reuse it to get a big speed increase. I have a need to stitch three videos. In case this is useful to someone else, this is what I did:

1. I have three videos I call left, center, and right. The code in this blog post is set up for one on the left and one on the right. My cameras are very wide angle and the center should be the "anchor"
2. I need to stitch the center first, so I stitch center and right. Starting here makes the center the "anchor" and distorts the right to fit.

3. Rotate the resulted stitched image 180 degrees and also the left image 180 degrees
4. Stitch the two rotated images. The rotation is so that the previously stitched image is on the left, making it the anchor.
5. Rotate the resulting image 180 degrees, leaving it in the original orientation.

I use Adrian's stitch class to store the homography matrices – I don't touch that, other than keeping two copies: one for the center, right and one for the stiched center right and the left.

Admittedly, this is a big hack, but it works well. If I were to take another stab at this, I would look more at the stitching code to see how I could define the right or left side as the "anchor" This would eliminate all the image rotation.

This approach, however hacky, leaves a lot of flexibility to stitch images in orientations other than the stock left right horizontal orientation.

Reply

Adrian Rosebrock

March 19, 2019 at 9:57 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-507818)

Thanks for sharing, Erik!

Reply

Sushma Kumari

July 17, 2019 at 7:23 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-526054)

Hello Adrian and Erik,

I did all the steps what you have been suggested, but in the final output, I am not getting the three stitched videos. the left video is missing and only the center and right stitched video are there in the middle. please suggest me for correction, your help will be appreciated.

Reply

Filip

April 8, 2019 at 6:10 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-511796)

Is now with new opencv update, possible to take transformations and sittch frames in real-time?

Reply

Robin

April 16, 2019 at 3:35 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-513145)

Hi Adrian. How can I stitch the images together without having a cropped result so that no information is lost? I would like to do something similar to “Image Stitching with OpenCV and Python” using the “Simple” method, but with two frames in real-time.

Reply

Adrian Rosebrock

April 18, 2019 at 6:52 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-513429)

This method doesn’t crop out the center and keeps the “black” regions of the image after the transform so I’m not sure I understand your question?

Reply

sushma kumeri

May 17, 2019 at 12:50 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-518011)

Hello Adrian,
I am trying to stitch two real-time videos, But the output frame is continuously changing its frame size and create flicker in the display window. Please hint me some solution.

Reply

Adrian Rosebrock

May 23, 2019 at 10:17 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-518958)

It sounds like there's not enough keypoints being matched to reliably construct the homography matrix. Try using a different set of keypoint detectors and local invariant descriptors.

Reply

Aravind Sethu

July 23, 2019 at 2:11 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-526854)

Hi Adrian,

I am trying to do the stitching using two webcams(one logitech 310hd and pc inbuilt cam) . While running the code the right side of the panorama always seems to be either distorted or fully black or a small portion displayed. What might be the reason?

Reply

Adrian Rosebrock

July 25, 2019 at 9:31 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-527245)

It sounds like the keypoint matching resulted in a poor homography matrix. Try a different keypoint detector and/or local invariant descriptor.

Reply

Steve Constable

August 16, 2019 at 4:04 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-539120)

Aravind, did you ever come up with a solution?
I am having the exact same problem and wonder if you can post your solution if you found one.
Thank you very much!
-Steve

Reply

Yumin Lee

September 12, 2019 at 4:03 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-550072)

Hi Adrian,

thanks for your tutorials.

I am trying to build a GUI(in Pyqt5) for this panorama stitching Video, but it always came to an error calls ‘unhandled AttributeError: builtin_function_or_method object has no attribute”shape”.’ it seems like it happened in the file named ‘convenience.py’ and it’s located at the function “def resize”. maybe you know the reason why?

ps: the original codes worked perfectly, but this problem came when I try to combine the codes with my GUI codes.

or maybe can you please give me some advices?

Thank you very much.
Best regards.

Reply

Adrian Rosebrock

September 12, 2019 at 11:28 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-550317)

Sorry, it’s pretty hard to know without seeing your source code. Perhaps follow **these suggestions. (https://www.pyimagesearch.com/faqs/single-faq/i-tried-to-run-your-code-from-a-tutorial-but-got-an-error-can-you-help-me)**

Reply

Imran B (http://Splendio.com)

December 26, 2019 at 4:04 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-617097)

I think you haven’t attached camera’s check with that and try

Reply

vinay

November 25, 2019 at 5:48 am (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-582752)

thanks for your tutorial.
i was just wondering will it work the same with 10 cameras at at once?

Reply

Maha Alhosani

February 18, 2020 at 1:59 pm (https://www.pyimagesearch.com/2016/01/25/real-time-panorama-and-image-stitching-with-opencv/#comment-739321)

would you recommend using a GoPro or an IP camera for image processing using OpenCV as I'm currently working on a project and have faced multiple issues with choosing the appropriate type of camera to use instead of a webcam

Reply

Before you leave a comment...

Hey, Adrian here, author of the PyImageSearch blog. I'd love to hear from you, but before you submit a comment, **please follow these guidelines:**

- **If you have a question, read the comments first.** You should also search this page (i.e., ctrl + f) for keywords related to your question. It's likely that I have already addressed your question in the comments.
- **If you are copying and pasting code/terminal output, please don't.** Reviewing another programmers' code is a very time consuming and tedious task, and due to the volume of emails and contact requests I receive, I simply cannot do it.
- **Be respectful of the space.** I put a lot of my own personal time into creating these free weekly tutorials. On average, each tutorial takes me 15-20 hours to put together. I love offering these guides to you and I take pride in the content I create. Therefore, I will not approve comments that include large code blocks/terminal output as it destroys the formatting of the page. Kindly

be respectful of this space.

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Thank you for keeping these guidelines in mind before submitting your comment.

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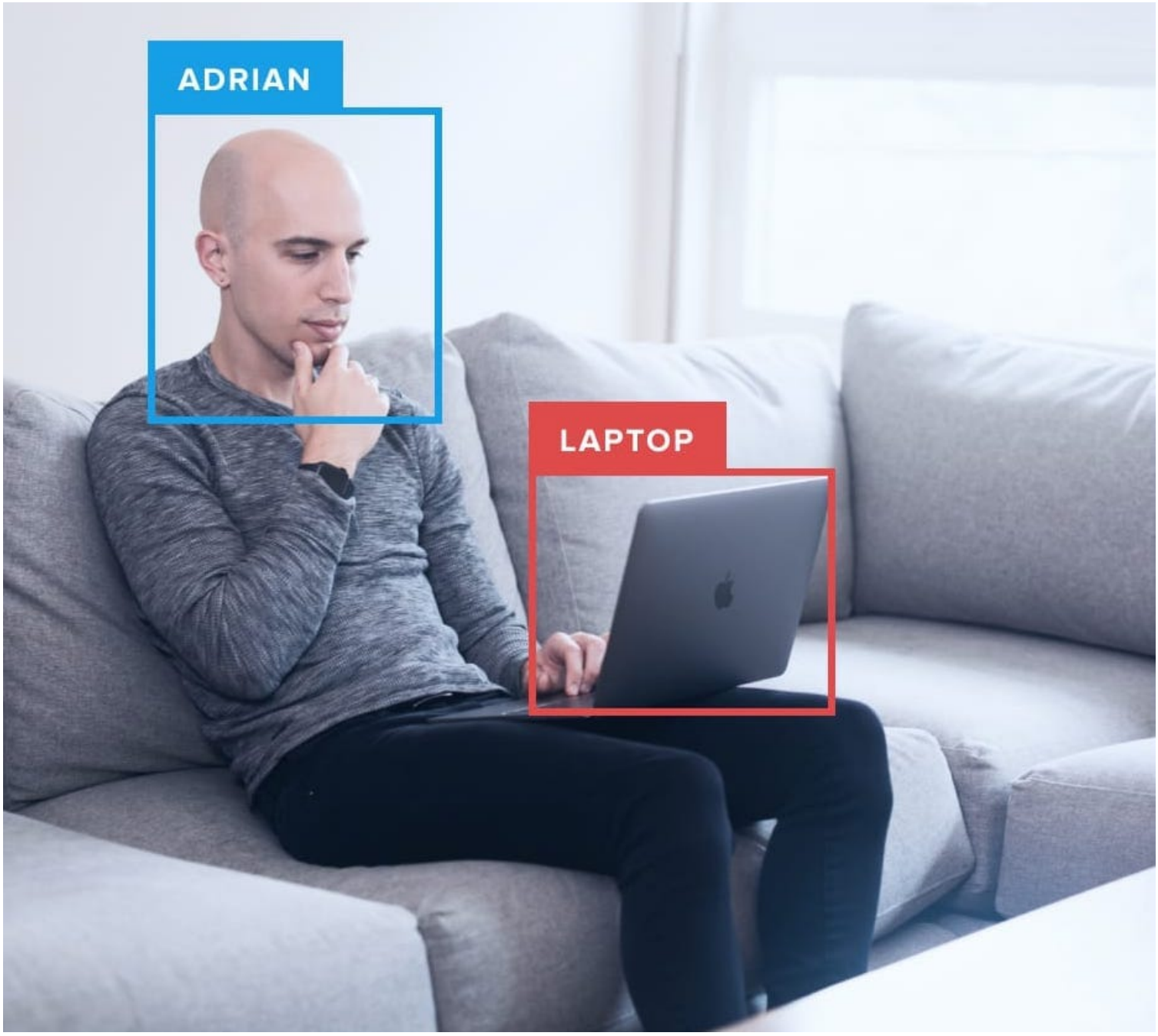

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