CV-Challenge

G18
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1 Introduction

In this year, online-meeting tools are becoming more and more useful because of the current situation. When we join the meeting, we don't want others to see our private space. In this report we will show our algorithms which realize the "Virtual Background" to solve such a problem. The background and the foreground of an Image can be separated and a foreground mask is generated. In section 2, we will explain the Algorithms with some instructions on how to run the program in section 3. In section 4, the final results will be showed. Section 5 is the conclusion.

2 Algorithm

In this section the functions and the methods will be explained. The basic method to achieve the extraction of Background is Background-difference.[1]

2.1 main idea

Background-difference method is a general method for motion segmentation of still scene. It makes difference operation between the current image frame and the background image to get the gray image of the moving area of the target. The gray image is thresholded to extract the moving area. In order to avoid the influence of environmental illumination, the background image is updated according to the current acquired image frame.
According to foreground detection, background maintenance and the post-processing methods, there are several different background subtraction methods. I_T, B_T are the current frame image and background frame image respectively, and T is the foreground gray threshold, N is the number of following images.
The methods is as follows:

1. The average value of the follow N frames is taken as the initial background image B_T;

2. compute the difference between current frame image I_T and background image B_T. The formula is: $|I_T(x, y) - B_T(x, y)|$

3. For the pixel $(x, y)$of the current frame, if there is $|I_T(x, y) - B_T(x, y)| > T$, then the pixel is the front scenic spot;

4. The background image is updated with the current frame image;

2.2 algorithm structure

The advantages and disadvantages of background difference are as follows:

- Advantages: The algorithm is simple. It can overcome the changes of light.
- Disadvantages: Cameras cannot be used for motion and it is difficult to update the background image in real time.

To get the better result, N should be as large as possible. But it takes such long time to read more pictures. To improve the efficiency, the Background will only be updated every N images. After every N image, next K images will be imported to compute the Background for next N images.
During the processing of next N images only one image will be imported. In this way, we can get a better Trade-Off between Run-time and final result.
The Algorithms structure is as follows:

Algorithm 1 background difference

input : N images $I = \{I_1, I_2, ..., I_N\}$
output: N mask $M = \{M_1, M_2, ..., M_N\}$
Initialize $i \leftarrow 1$
repeat
  load next K images to compute the background bg;
  $bg \leftarrow mode(I_1, I_2, ..., I_K)$
  lode next 1 image and compute the difference df;
  $df \leftarrow abs(I_i - bg)$
  if $df(X, Y) > thresholdT$ **then**
    $df(X, Y) = 1$
  else
    $df(X, Y) = 0$
  end if
  Filter(df);
  return mask $M = \{M_1, M_2, ..., M_N\}$
until i=N;

3 Program

3.1 Imagereader

Class Imagereader is the class for initialization. Src, N, R, L, Start are the same as the Properties which are defined in Computer_Vision_Challenge_2020. Two important additional parameters are added. left_dir is the directory for the left_camera_tensor and right_dir is the directory for right_camera_tensor. Two methods, constructor and $ir.next()$ are also the same as the methods defined in Computer_Vision_Challenge_2020.

3.2 Segmentation

The flow chart of function segmentation is shown as follows:

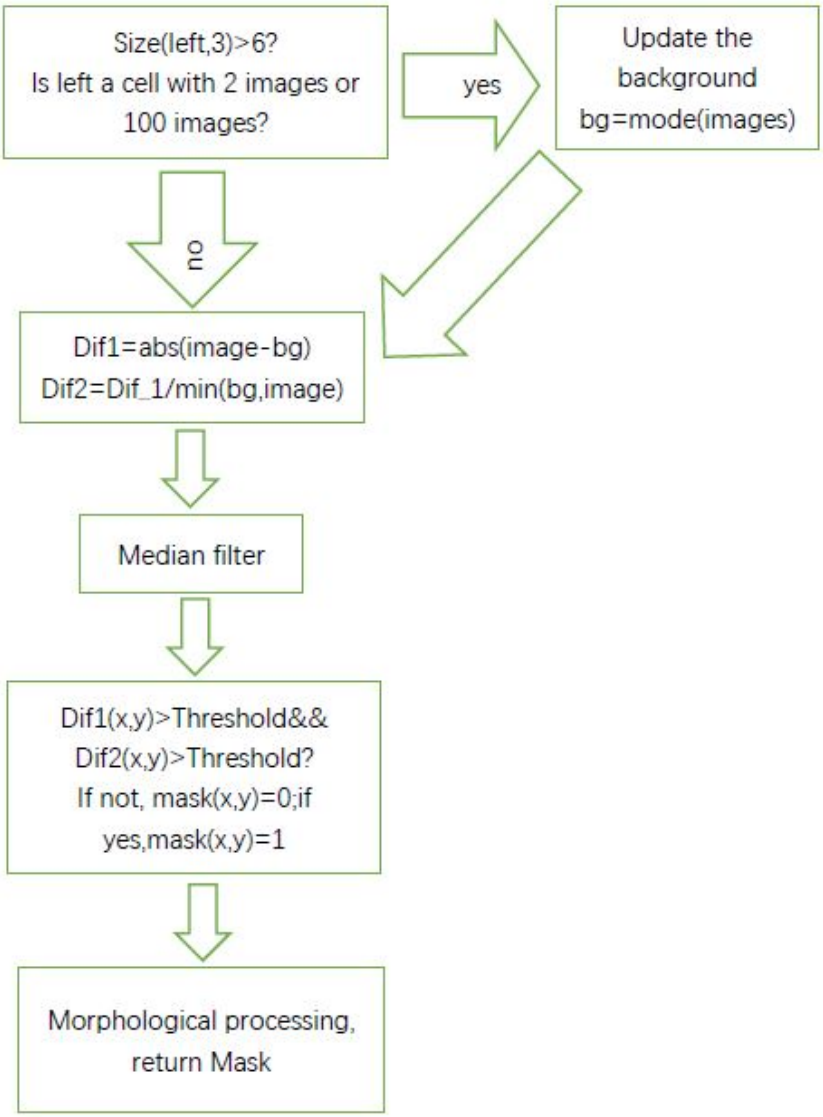


Figure 1: Segmentation

This part is the most important part in our program. It is used to generate the mask by using the background difference algorithm.

3.3 Render

The flow chart of function render is shown as follows:

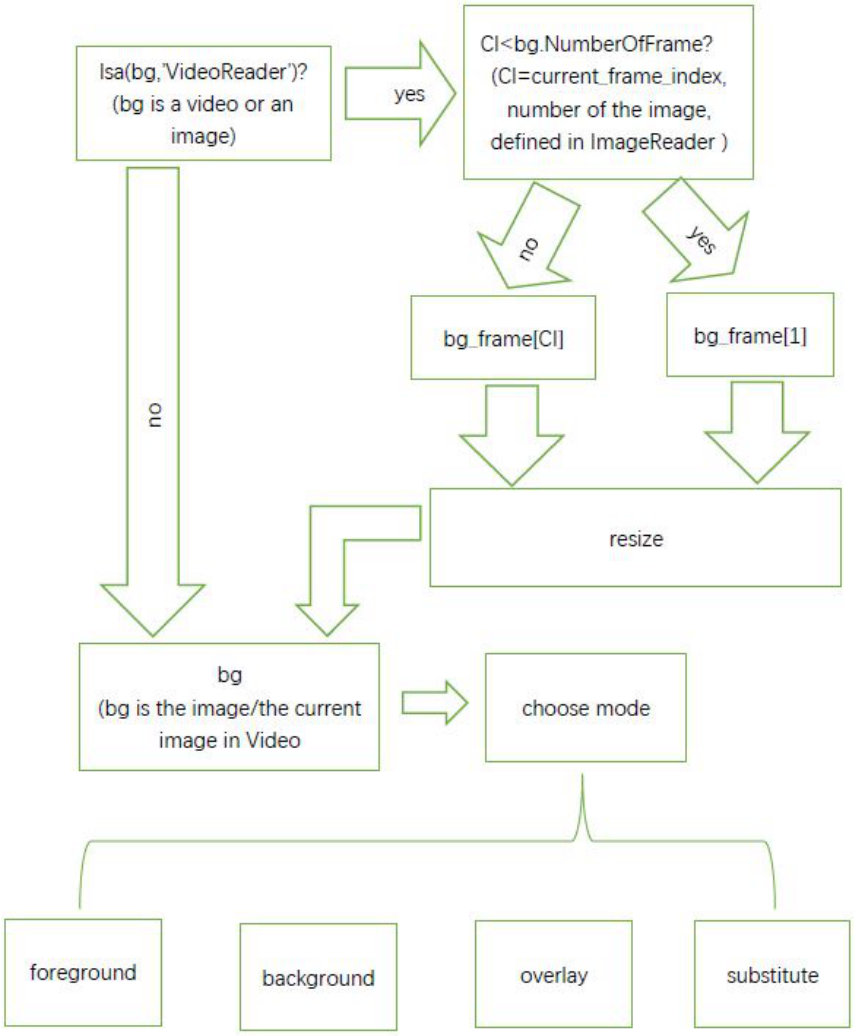


Figure 2: Render

In this function, the current image of the left camera frame can be processed using the corresponding mask from the result of segmentation function.
There are four modes:

- foreground: The background is set to black.
- background: The foreground is set to black and only the background is visible.
- overlay: Foreground and background are set to different colors.

- substitute: Replaces the background with a virtual background which is passed in bg. It will be resize if the size of bg is different from the size of our image set.

3.4 Challenge

The script challenge.m executes the previously implemented functions in a loop until the selected scene folder is finished. It can measure the time that is needed to execute the task and save the value in the variable elapsed_time and display it in the command window.
The flow chart of challenge file is shown as follows:

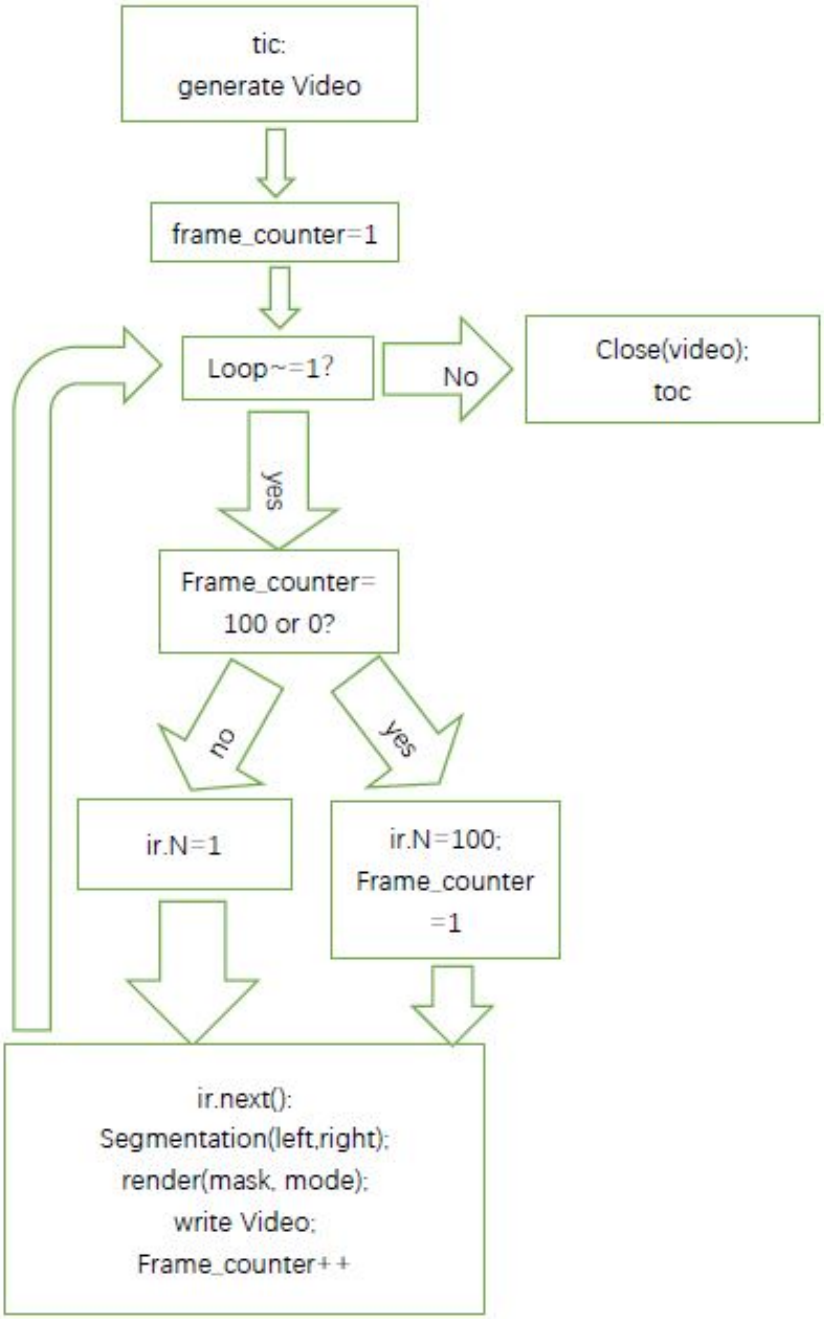


Figure 3: Challenge

3.5 GUI

A GUI displays objects that convey information, and represent actions that can be taken by the user. A GUI is considered to be more user-friendly than a text-based command-line interface.
Our GUI is shown as follows:

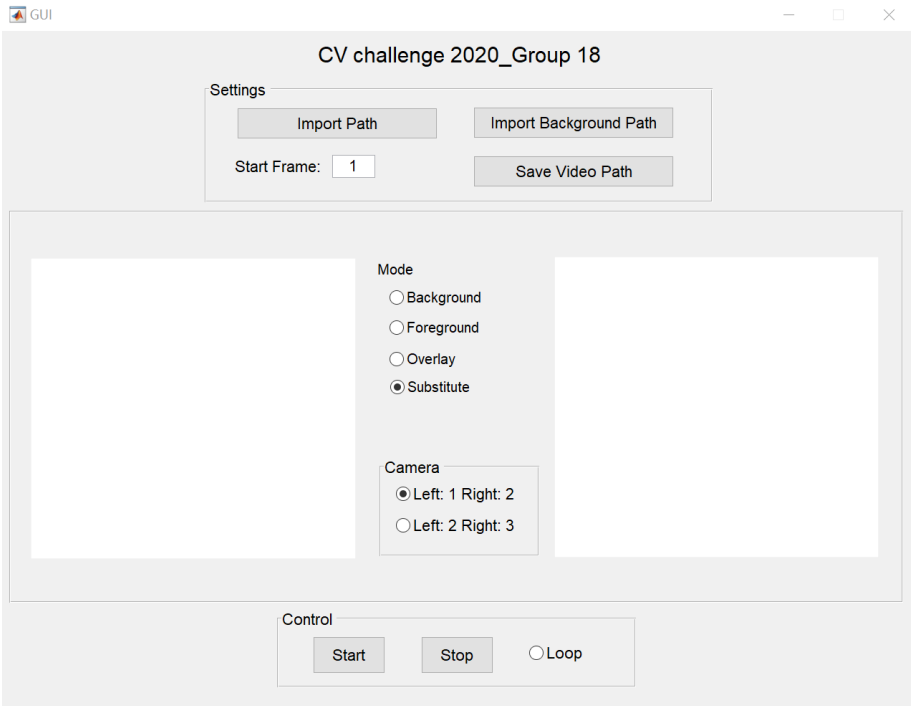


Figure 4: GUI

Instructions on how to run the Program:

1. RUN GUI.m in Matlab, GUI should pop up.
2. Choose the dataset: click "Import Path" in panel Settings and select directory of Database (Original Image-stream)
3. Select Background (video or image): click "Import Background" in panel Settings and select directory of Background. Background can be image or video. ('*.jpg *.tif *.png *.bmp *.avi *.mp4' are acceptable formats)
4. Select path of output video: click "Save Video Path" in panel Settings and select the directory of Output Video. (Please note that if you want

to save the processing result as a video, you should select the directory before image processing. The video will be saved automatically after the process stops.)

5. Choose the Start frame, Mode, Camera and loop. (default_Start = 1, default_Mode = Background, default_Camera = Left 1 Right 2, default loop = false)

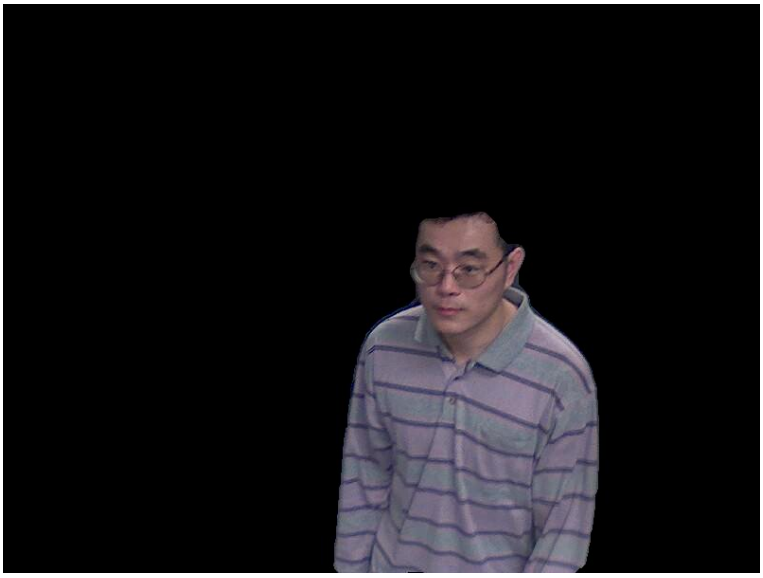
6. Press "Start", the image in the left is the processing image and the right image is the result.

7. Press "Stop" to stop the running program and save the video. When "loop" mode is selected, the program will process the first image after processing the last one until stop is pressed. When loop mode is not selected, the program will end and save the video after processing the last one.

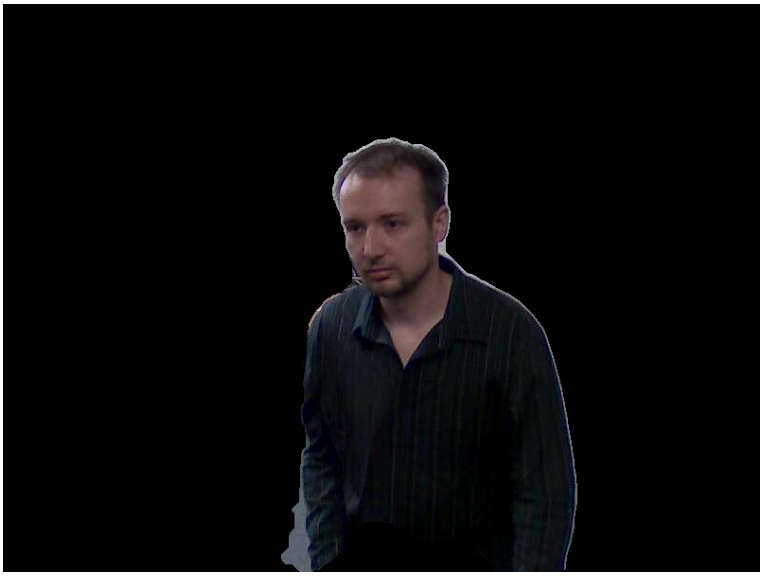
8. You can change your settings in steps (1) - (5) when and only when the process stops/ends. Please note that changing the settings while processing will not affect your current result.

4 Final Results

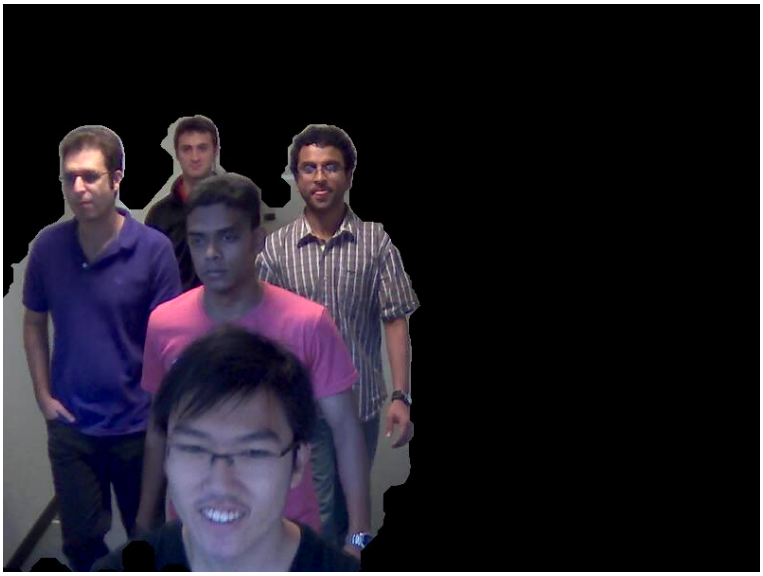
The folder P1E_S1, P1L_S3, P2L_S5, P2E_S2, P2E_S4 and P2E_S5 are choosen to test our program. The foreground mode is used and the final results are shown below.
P1E_S1:



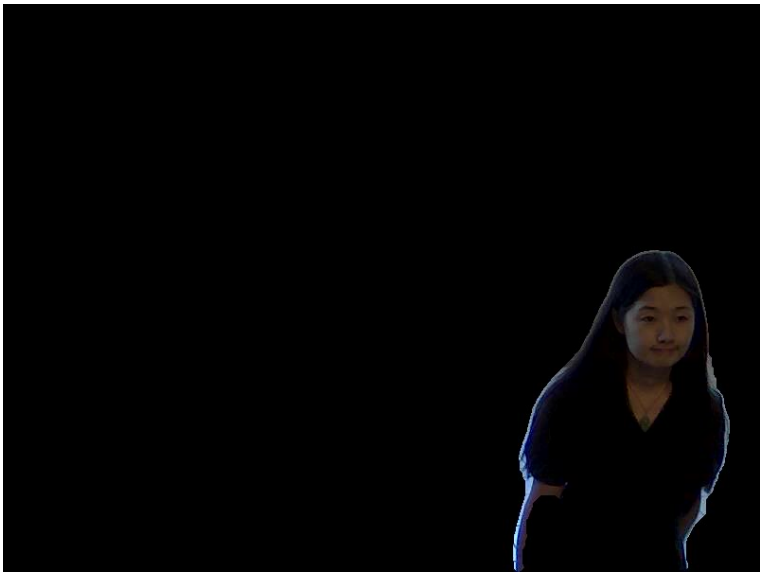
P1L_S3:



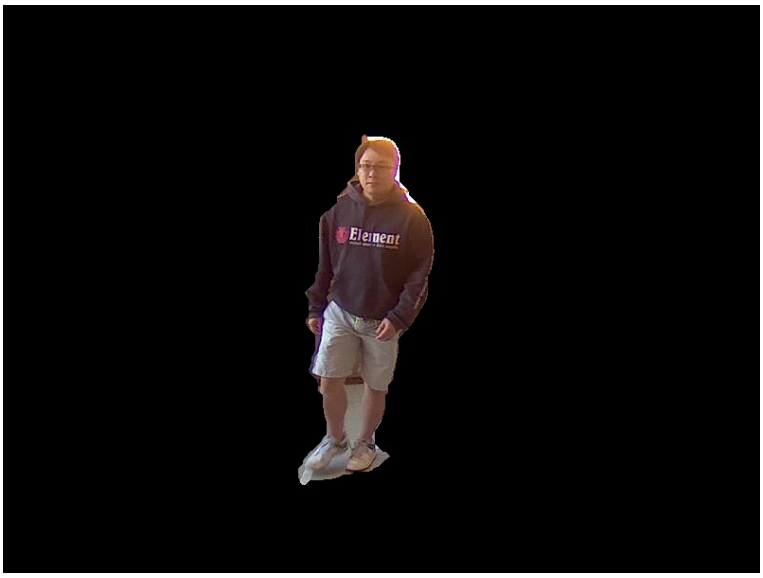
P2L_S5:



P2E_S2:



P2E_S4:



P2E_S5:

5 Conclusion

Our program can separate the background and the foreground in the 'Image Stream'. The fundamental method is background difference. During the working period we have tested also the other methods, such as Frame difference with edge-filter, deep-learning. Compared with the other methods, we choose background difference. The running time of background difference is shorter.

The final results are not so good during the whole Image-stream. Sometimes same color clothes of one person are recognized as background. But we still not find a good way to solve this problem because of the limit of running time.

To achieve a better result as shown in Zoom. Deep Learning method is also necessary. More Database with different faces is also essential for this method.

References

[1] J. Yu, X. Zhou, and F. Qian. "A novel approach for moving object detection based on improved particle swarm optimization algorithm". In: *IEEE ICCA 2010*. 2010, pp. 1178–1183.