Background Subtractor

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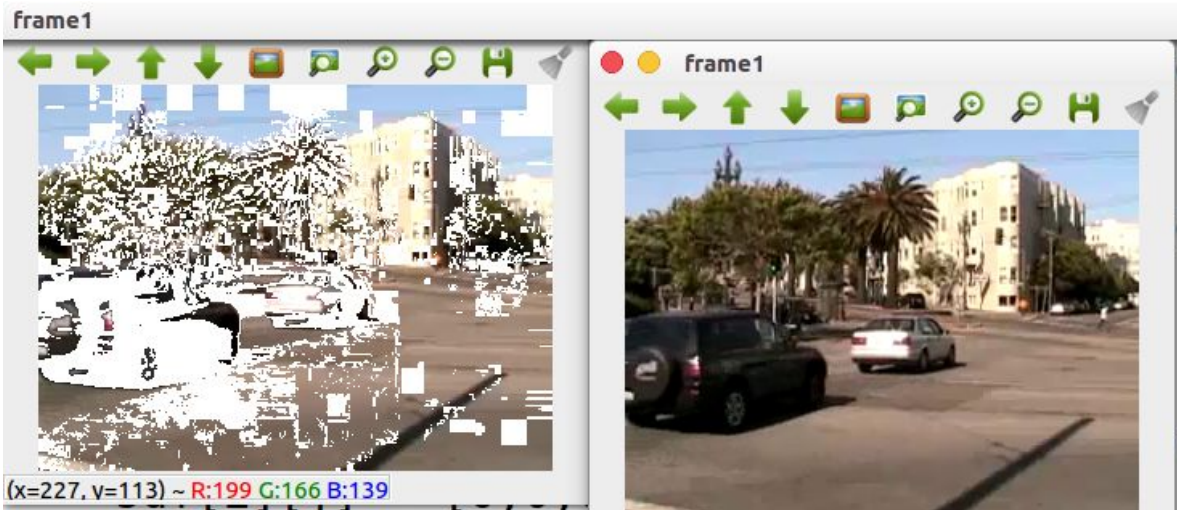
1.1 Model and Library Used

I Implemented 2 different models for background subtraction. First one is a simple model based on average of the accumulated pixel values of the frames with time. Second one is the mixture of Gaussian Models as given in HAL research paper. The results for both the models were compared with the MOG function given in the openCV library.

1.2 Implementation

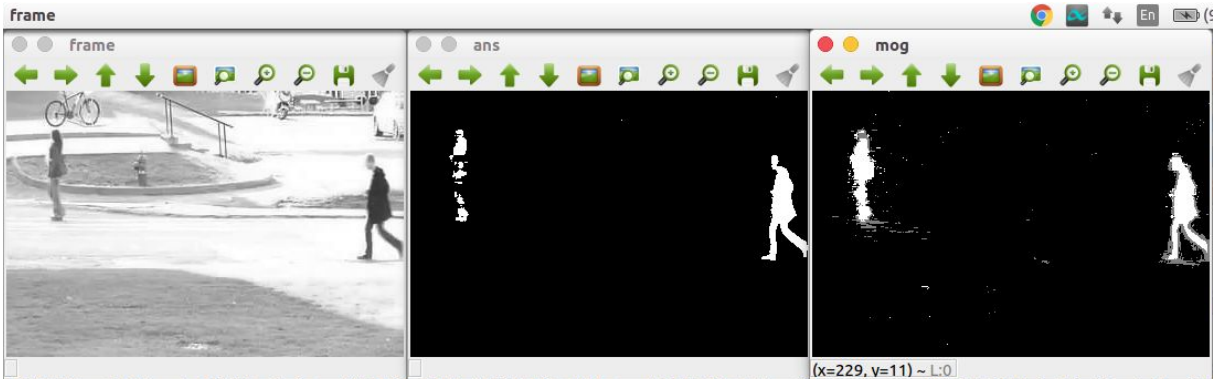
For the first implementation, a basic model is used in which the value of each pixel is subtracted from the average value of the pixel.For calculating the image containing only the background, a series of preceding images are averaged. Then if the difference of pixel value and background is greater than threshold then it is qualified as foreground. The model seems to provide only coarse outline of the background.



The white portion is identified as foreground by using the model of means.

For the second implementation, mixture of 2 gaussians were used. The values of other parameters were tweaked to obtain good results. The

values of mean were initialized to be equal to the first frame. One of the gaussian was given a higher variance and other one was given the lower.
Similarly the weights were also given differently to the two gaussians. Also the classification of background / foreground was done using the wt/var values. The values were updated with each frame as per given in the paper. The middle one shows some basic result of the implementation.

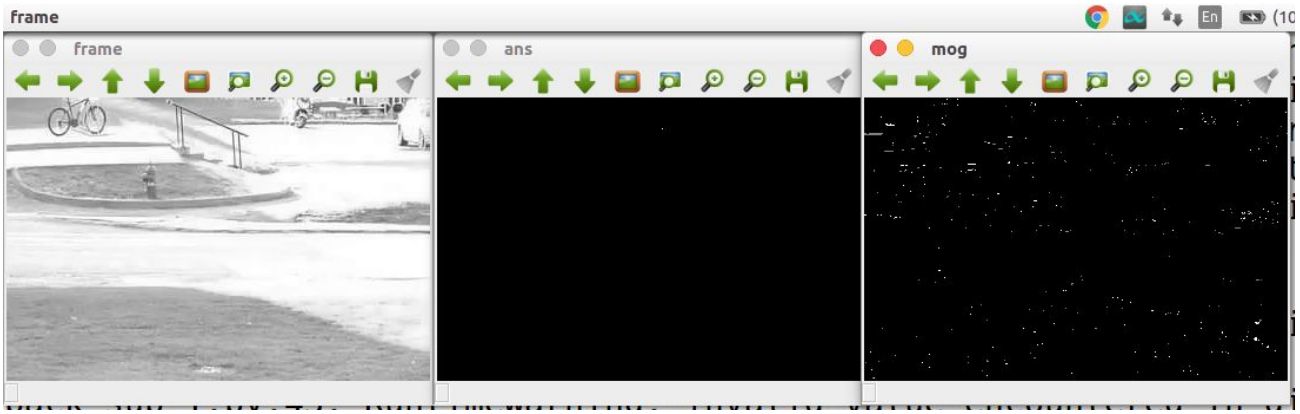


Then, the background subtraction is done using Mixture of Gaussian Model. OpenCV library is used.

The values where the background subtractor library gave less than the threshold values, the average value of pixel was put to give the background.

1.3 Results

Some of the basic results can be seen from the screenshots above. The second implementation was able to produce some excellent results. It produced more stable results than the background subtractor of the openCV in the sense that there were no “white spots” visible in the background. (which may be due to choice of K=2)



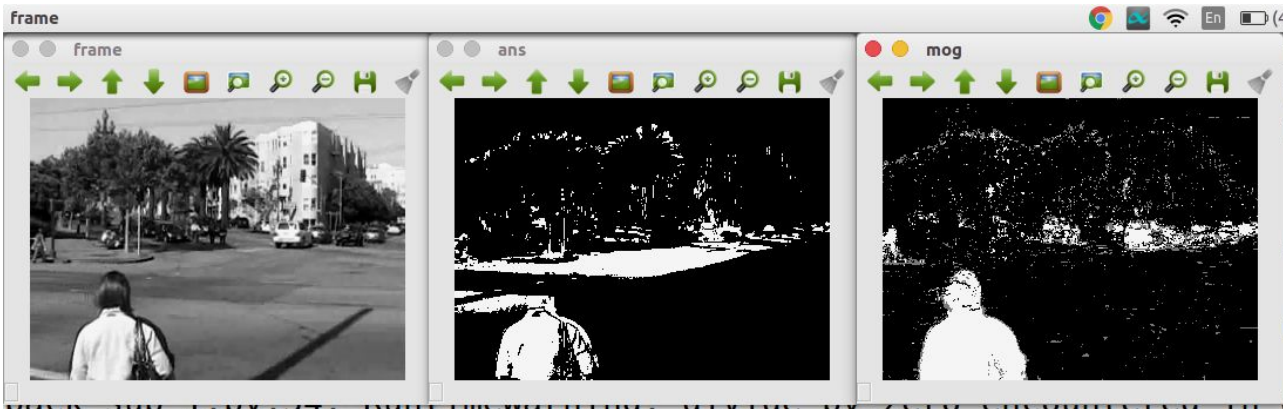
1.3.1 Effect of Parameters

The code was run for various values of the parameters and results were found have been listed below:-

Alpha = 0.01, wt = (0.6,0,4) , k =2.5

However as the value of k is increased there is more chance that the pixel value which was converted into foreground can now convert back to background easily. The following result is obtained with the parameters

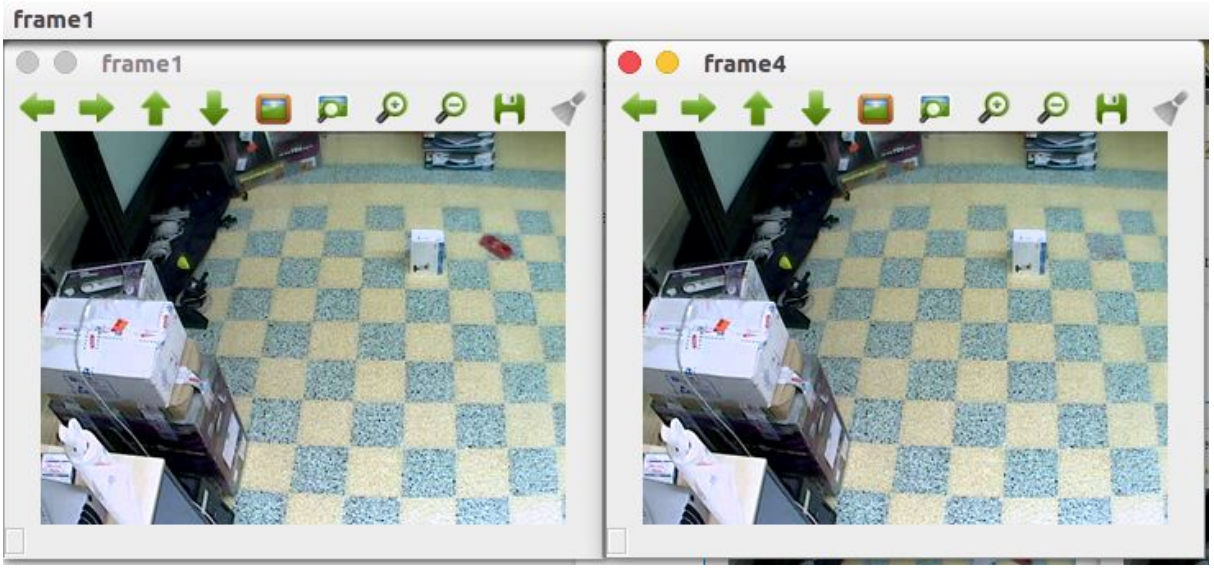
Alpha = 0.01 , wt = (0.6,0,4) , k = 5



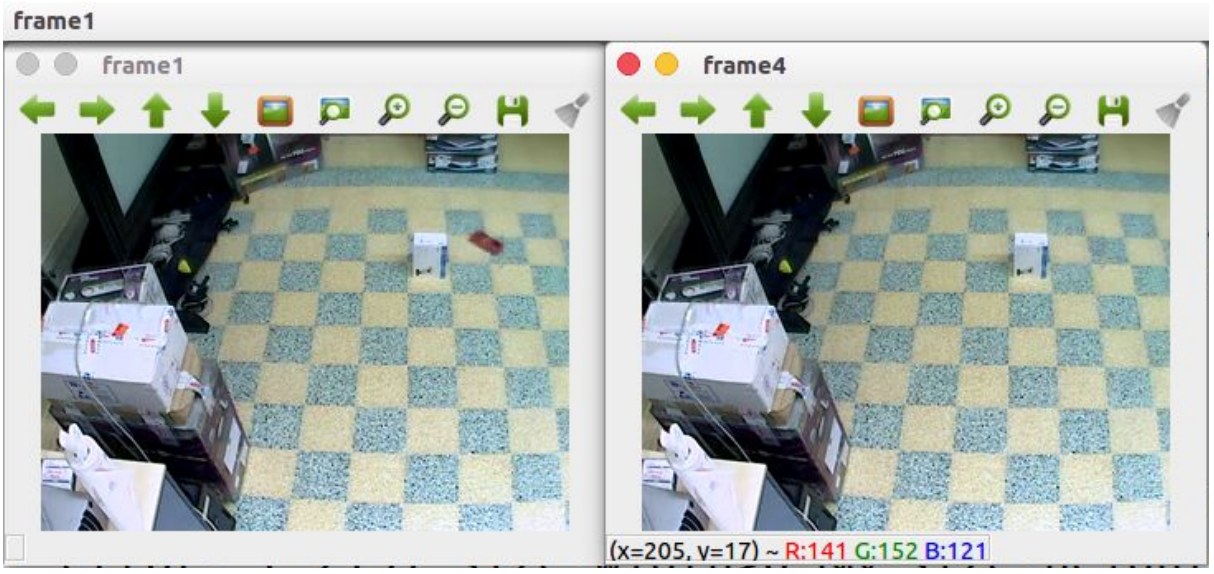
The code for the gaussian model was run through various samples videos to analyse the output of the function in different situations. Some of the observations are listed below.

1.3.2 Speed of the foreground object

The results were obtained by changing the frames per second of the same video.



The result obtained on original video

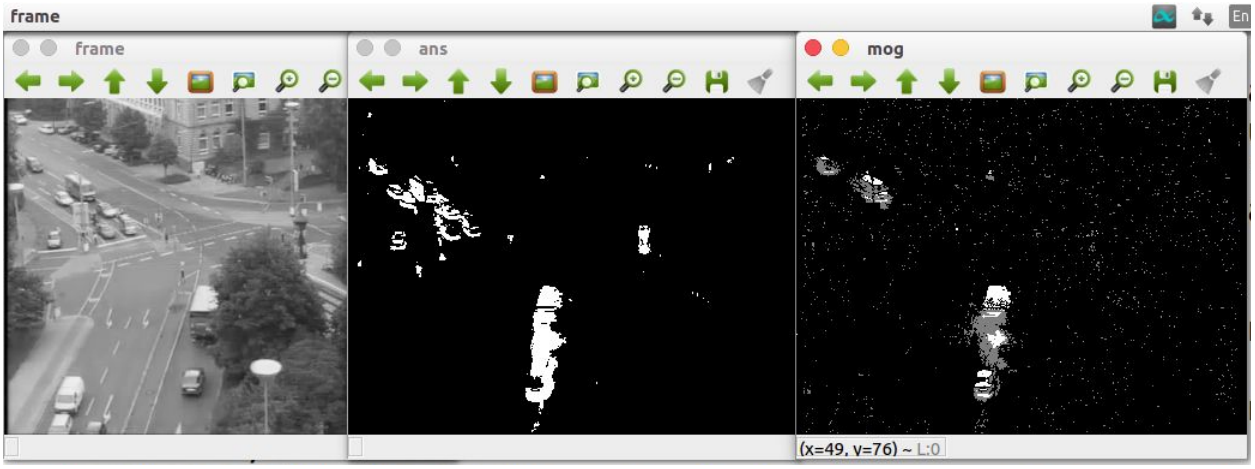


The result obtained on video after 2x speedup

For the above video the result remained almost same. Equally good results were obtained for both original and faster video.

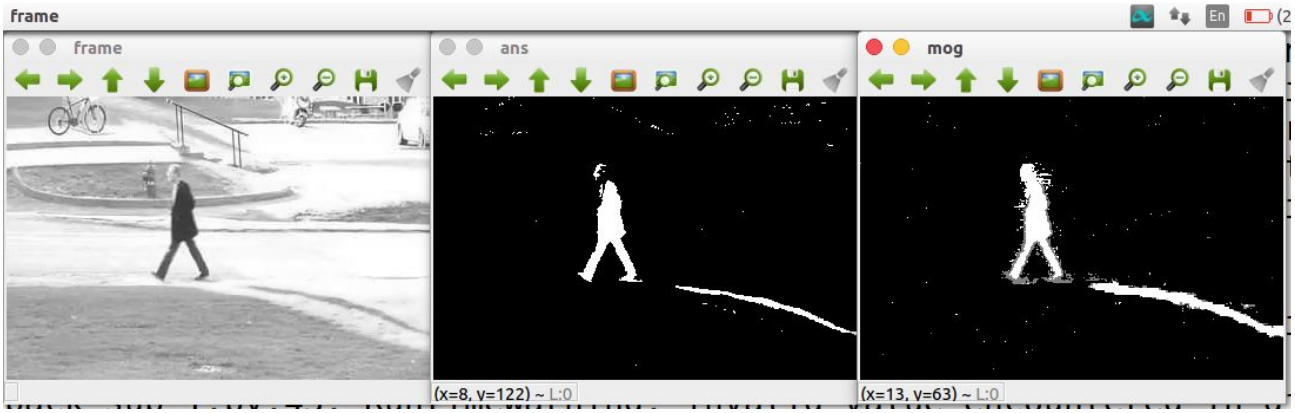
1.3.3 Foreground object stationary for a while

The second implementation and MOG were compared on a video in which few foreground objects were made to remain stationary for a long time. Such objects are available in Sample3.mp4. Cars on the left in the image below are the ones that were stopped on the road and in my implementation with parameters(Alpha = 0.01, wt = (0.6,0,4) , k =2.5) they remained to be foreground while the MOG of openCV changed them to background slowly. This may be due to slow increase of weight and low confidence in newer pixels in my implementation.



1.3.4 Effect of shadows

The shadows play a crucial role in understanding the effect of background subtraction. For my implementation which uses only 2 gaussians it is not possible to distinguish shadow and foreground. And hence moving shadow is taken as a part of the foreground object which can be seen from the image below. The trail of shadow of the person can be seen in both the models.



However the effect of stationary shadows of the background objects can be clearly seen. Whenever a foreground object comes over such a shadow the part of it on which shadow falls remain classified as background only. See the effect of shadow of the lamp post on the person in following image.