Adaptively Adjusted GMM based Background Segmentation for Surveillance System

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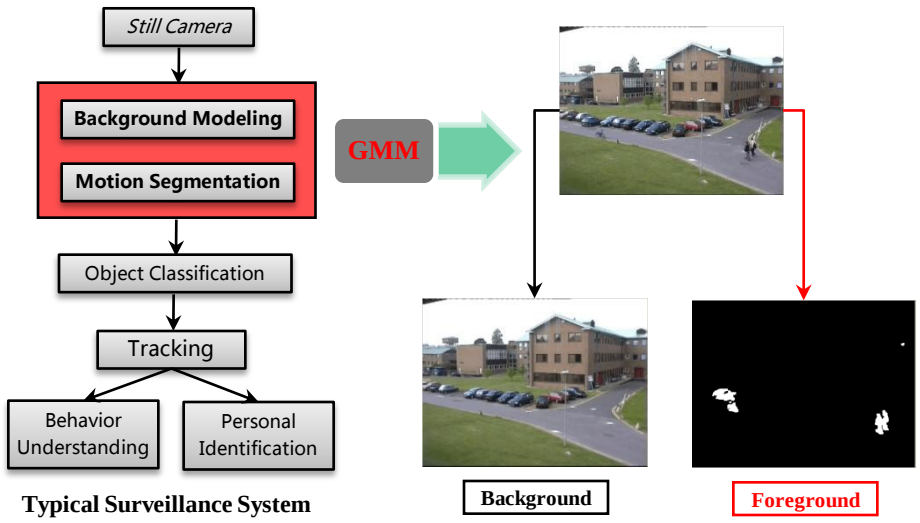
Research Contents

◆ Gaussian Mixture Model



Typical Surveillance System

◆ Adaptively Adjusted Mechanism

Scheme: The L-recent window update equations give priority over recent data, therefore the tracker can adapt to changes in environment. When a new pixel value comes, check it against first $N_{i,j}$ Gaussian distributions in turn. If the i_{th} distribution G_i matches, update parameters as M-step in EM does. After that, we compare the value of with value of . If $w_i/\sigma_i > w_{i-1}/\sigma_{i-1}$, exchange the order of G_i and G_{i-1} and operate i=i-1, repeat it until i=1 or $w_i/\sigma_i < w_{i-1}/\sigma_{i-1}$. Or else no match found, operate as follows:

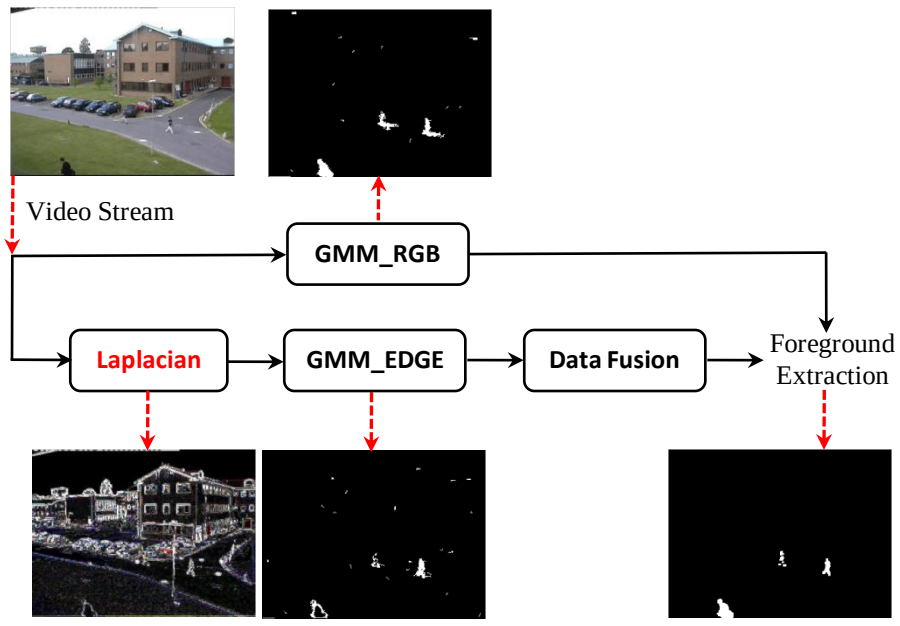
$$N_{i,j} = \begin{cases} N_{i,j}+1 & If \quad N_{i,j} < K \\ K & If \quad N_{i,j} = K \end{cases} \qquad (1)$$

$$w_k = \frac{w_k}{\sum_{i=1}^{N_{i,j}} w_i}, \quad k = 1,2,...N_{i,j} \qquad (2)$$

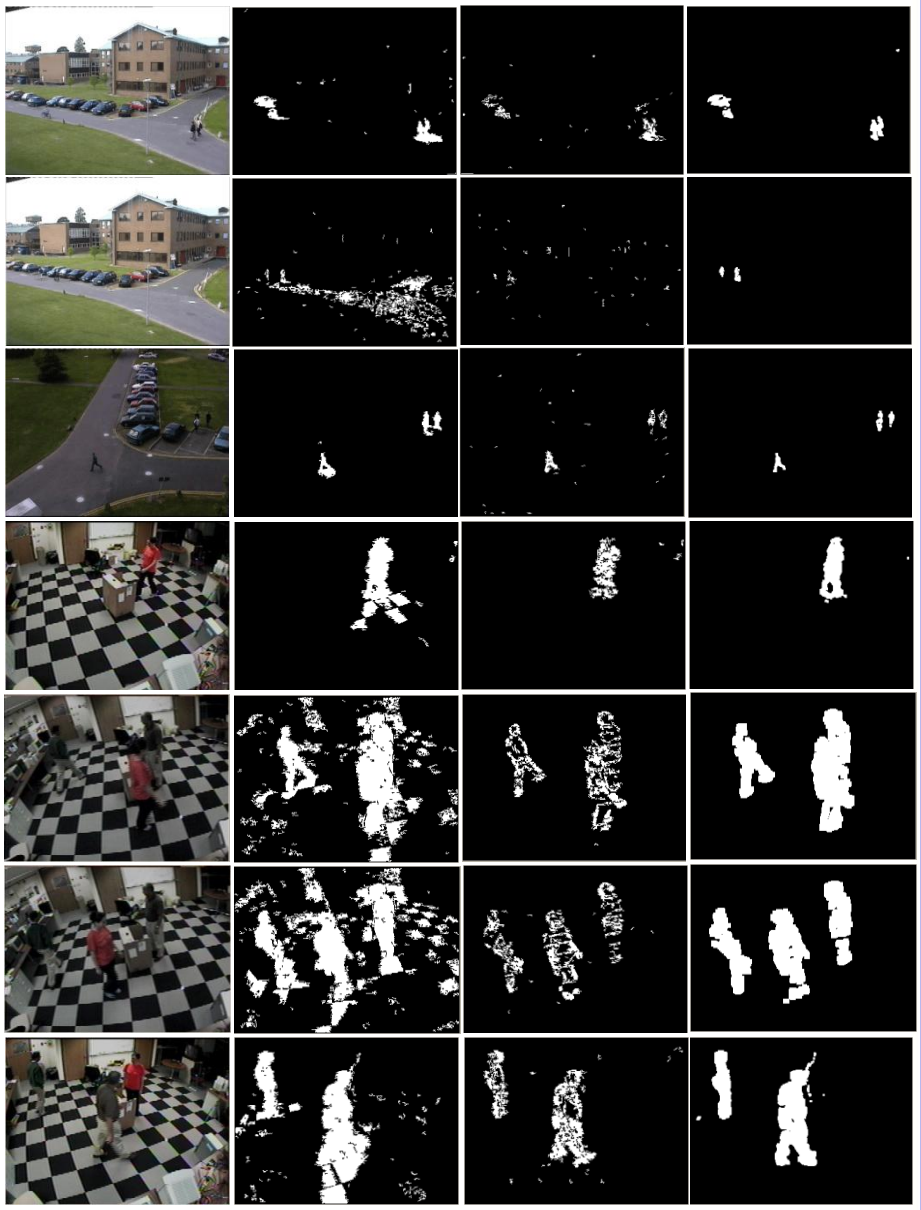
then replace the mean value of the $N_{i,j}^{th}$ distribution with current pixel. After that the Gaussians are eliminated from least updated ones according to two parameters: value of weight, which represent the time proportions that those colors stay in the scene and *sum_match*, which takes for the percentage of importance in K guassians to dominant background component from training history. We subtract the weight of the last Gaussian from that of the one before the last, if the difference is less that threshold D = 0.001 and *sum_match* <= 3, remove the last Gaussian and repeat this, as the pseudocode shown below. Then the weights of left Gaussian distributions are reassigned as below

```
For ( i=N_{i,j} ; i>0 ; i-- )
  Begin
    if ( weight_of_G_{i-1} - weight_of_G_i < 0.001 && sum_match  <= 3 )
       Remove_Gaussian(G_i);
    else break;
End.
```

◆ Foreground Mask



◆ Experimental Results

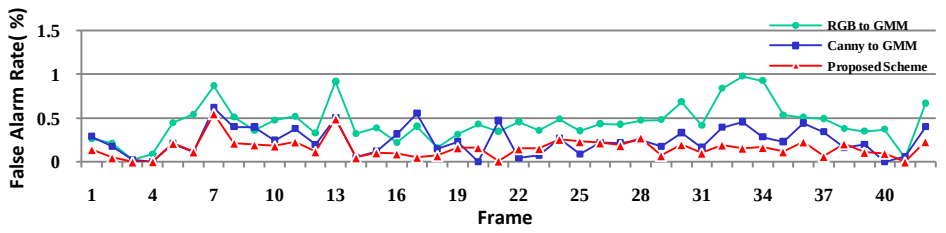


(a)　(b)　(c)　(d)

Figure 2. Comparison of foreground detection: (a) original frames: frame 1867 and 2253 from PetsD2TeC2, frame 1118 from PetsD1TeC2, frame 132 and 265 from ThreePerson_Circles Comp_0_Quad0, frame 257 and 266 from ThreePerson_Together_Split_Comp_0_Quad3 (from up to bottom respectively); (b) Foreground mask by applying improved GMM on RGB color space. (c) Foreground mask by applying improved GMM on Canny edge segmented image. (d) Foreground mask by proposed algorithm.

Table 1. Percentage for saved Gaussain

Sequence	Value of K in E_step	K=5	K=4	K=3	K=2
PetsD1TeC2 (Outdoor Sequence)	Original GMM	552960	442368	331776	221184
	Proposed	373297	360490	321301	220534
	Saved (%)	32.5%	18.5%	3.16%	0.29%
ThreePerson_Circles_Comp_0_Quad0 (Indoor Sequence)	Original GMM	384000	307200	230400	153600
	Proposed	249931	239614	211520	152879
	Saved (%)	34. 9%	22.0%	8.19%	0.47%



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