Summer Design Project : Week 7 Report

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***Abstract*—Here we present a straightforward implementation of Gaussian Mixture Model(GMM) for background subtraction/foreground extraction in a video, without improving the algorithm for efficiency or speed. We do not attempt at explaining the mathematical theory behind GMM. Implementation of GMM and corresponding results are included in the report.**

I. Introduction

IN THE past weeks we have explored some methods to track the movement of objects in a video. Our aim for this week was to use Gaussian Mixture model based background subtraction. Since most animated video will have a static background and a moving foreground, GMM can be efficiently used. This report shows the implementation and corresponding results without going into mathematical details of how GMM works . Gaussian Mixture is a probabilistic model wherein we assume that all the observation points are generated out of a mixture of a finite number of Gaussian distributions with unknown parameters. We use this in background subtraction by selecting random points on a frame then keeping a track of these points. Then we check this $history$ of these points to determine what areas are static and what areas are moving in the image. Those with motion more than a determined threshold are concluded to be a part of the foreground and the rest of the static area falls in the background.

II. Literature Survey

We have referred to two papers by Z. Zivkovic [1] and [2], both presenting various methods of using Gaussian Mixture Model to subtract a static background froma moving foreground. Methods chalked out in both these papers work very well when the background is static with respect to the foreground and is good at handling occlusions of moving bodies over each other as well as the static background environment. Noise does occur in all the methods but can be morphologically eliminated.

III. Experiments and Results

This section shows the results of our implementation. Figures 1 and 3 show 3 frames captured from the $Pedestrians$ video, their backgrounds subtracted and the foreground masks are shown in white. Shadows are also moving components of the video and hence can be included in the foreground mask. The shadows are depicted in grey.
Figures 4 and 6 show 3 frames captured from the $Hand$ video, their backgrounds subtracted and the foreground masks are shown in white. The shadows of the moving hand are not included in the foreground mask in this case.

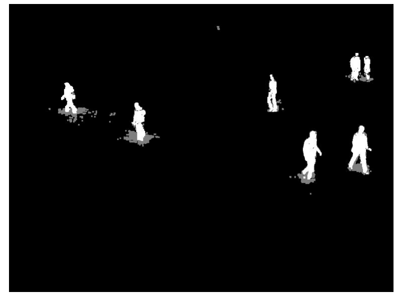

Fig. 1. Frame: 70

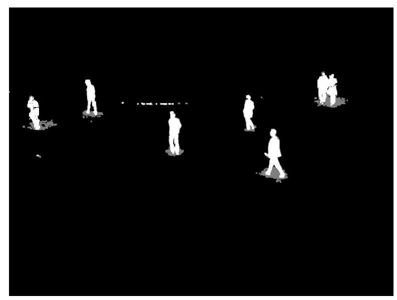

Fig. 2. Frame: 124

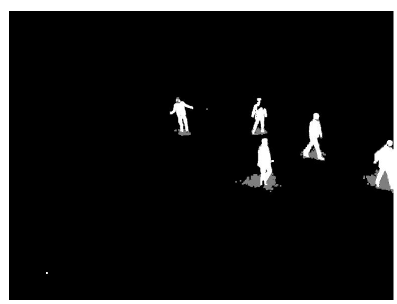

Fig. 3. Frame: 614

Fig. 4. Frame: 21

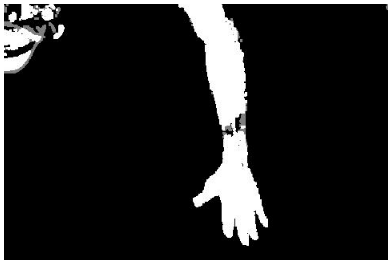

Fig. 5. Frame: 160

Fig. 6. Frame: 421

IV. Future works

As shown above, we have been able to subtract a static background from a moving foreground. The next step we are working on is separating individual objects from this foreground mask. We are using active contours/ snakes to separate the individual objects from each other. Once these objects are separated from one another, the next step is to track them over the video sequence which we have already determined a way for.

References

[1] Z. Zivkovic, *Improved Adaptive Gaussian Mixture model for Background Subtraction, 2004*

[2] Z. Zivkovic, *Efficient Adaptive Density Estimation per Image Pixel for the Task of Background Subtraction. 2006*