ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

MOTION DETECTION BASED ON DISCRETE WAVELET TRANSFORM AND GAUSSIAN MIXTURE MODEL TECHNIQUE

***Nikhat A Khan *Sushanth KJ **Kripa and ***Nithin**

*Assistant Professor, Electronics and Communication Engineering department,BIT, Mangalore – 575001, Karnataka, India, nikks_0310@yahoo.com
*Assistant Professor, Electronics and Communication Engineering department,BIT, Mangalore – 575001, Karnataka, India, sushanthkj@gmail.com
**Assistant Professor, Electronics and Communication Engineering department,BIT, Mangalore – 575001, Karnataka, India , kripa.thkt@gmail.com
***Assistant Professor, Electronics and Communication Engineering department,BIT, Mangalore – 575001, Karnataka, India , nithin.kallya@gmail.com

ABSTRACT

Smart video surveillance has become a widely used method for detecting security threats in banks, department stores, highways, crowded public facilities, automatic navigation, human-computer interaction, virtual reality applications, borders and many others. Moving object detection is a challenging task for video surveillance applications. In many environments, the image of a video consists of a motion which needs to be identified. Two approaches effectively used for the detection of moving objects are Gaussian Mixture Model (GMM) and Discrete Wavelet Transform (DWT). A GMM is a parametric probability density function represented as weighted sum of Gaussian component densities. GMM uses probabilistic approach to extract the features in a biometric system. These features can be extracted by estimating the GMM parameters using Expectation-Maximization (EM) method. For moving object detection, this method estimates whether the pixel belongs to background or foreground. DWT technique provide us multi-resolution image and can decompose the original image into

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016
different sub-band images, which includes low and high frequency information. Therefore depending upon the demand, a person can choose the specific resolution image or sub and image. The combination of low resolution image obtained by DWT and frame difference method is used to detect the moving object efficiently.
Key Words : Gaussian Mixture Model (GMM), Discrete Wavelet Transform (DWT), Expectation-Maximization(EM).

I. INTRODUCTION

Detecting moving objects is a very important aspect in intelligent video surveillance system. Discrete Wavelet Transform (DWT) is a form of transformation which is linear that operates on a data vector. The length of a data vector is an integer power of two. The transformation is done to convert this data vector into a numerically different vector of the same length. DWT is a tool used to segment the data into frequency of different components, and then each components resolution matched to its scale.

DWT is computed by a series connection of filters (lowpass and highpass) followed by a factor of 2 down sampling (sub-sampling) [1]. An image is represented as a 2-D array of coefficients, where each coefficient represents the brightness level at that point. Another technique commonly used for the moving object detection is Gaussian Mixture Model (GMM) technique for performing background segmentation. Staunffer and Grimson proposed a probabilistic approach for moving object detection using mixture of Gaussian. GMM is used for identifying the foreground objects from background. This technique identifies the background and the foreground pixels [7].

II. METHODOLOGY

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

Discrete Wavelet Transform (DWT) proposed by Mallat in the mid of 1980's, has been used in different fields such as image compression, image processing, biochemistry medicine, computer vision, signal processing etc. In image processing, this technique provide us multi resolution image and can decompose the original image into different sub-band images, which includes low and high frequency information [4].

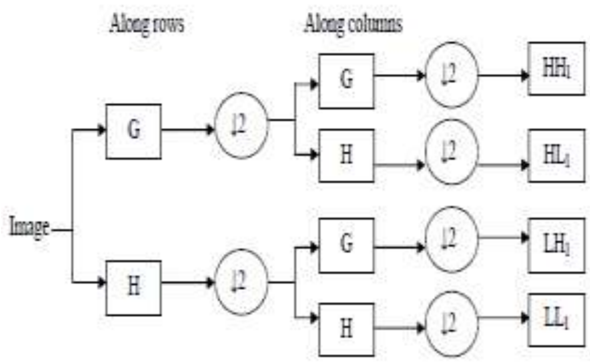


Figure 1(a): The 1-level 2-D analysis DWT image decomposition [4]

Therefore, depending upon the demand person can choose the specific resolution image or sub-band image. A 2-D DWT of an image is illustrated in Figure1.

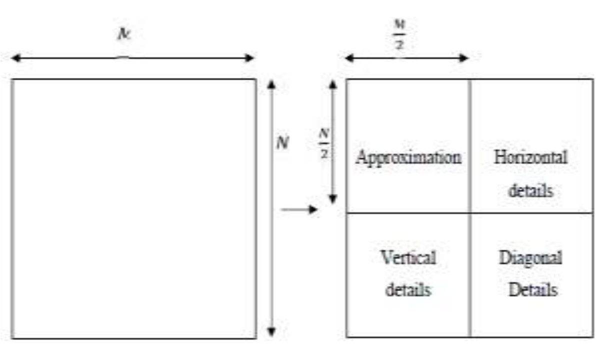


Figure 1(b): The transformation of original image into sub-band details [4]

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

Figure 1(a) and (b) shows the transformation of M*N image intofour sub-bands namely: Approximation, Horizontal, Vertical and Diagonal sub-band details. Each sub-band detail is of size M/2*N/2.

Figure: 2 Images of three consecutive frames in outdoor environment [4]

There are many of the noise issues related to 2-D DWT such as illumination changes, fake motion and noise in the background. Different low resolution (LL) band images of different level are used to deal with noises. Figure 2 to Figure 3 shows the motion detection in outdoor environment. Each level LL- -band image gives effective results while dealing with indoor noises, but while dealing with outdoor environment LL_1 band image gives poor results. This is because the noises in the outdoor environment are large, which sometimes cannot be completely eliminated.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

Figure 3(a): The temporal differencing results of the original image [4]

Figure 3(b): The temporal differencing results of LL_1band image [4]

Figure 3(c): The temporal differencing results of LL_2 band image [4]

Figure 3(d): The temporal differencing results of LL_2 band image [4]

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

III. IMPLEMENTATION

1. Discrete Wavelet Transform

The Figure 5.1 shows the implementation of the moving object detection using DWT. The implementation consists of five main steps namely: (i) 2-D DWT applied on three consecutive frames, (ii) Temporal difference between three frames, (iii) Binarization using threshold value, (iv) Morphological operation and (v) Constructing boundary box.

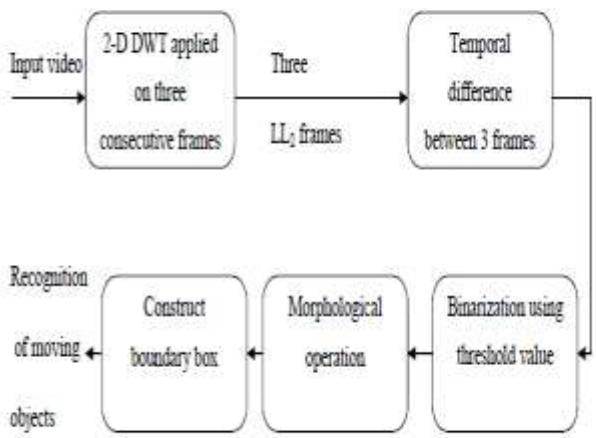


Figure 4: Block diagram of implementation of motion detection using DWT

Initially the video sequences are given as input. The input video frames can be a color image or a grayscale image. The input image needs to be converted into grayscale image if the input video is a color image. The pixel value of the grayscale image will vary from 0-255. To detect the moving object from a current frame, we need to consider both previous and next frame. A two dimensional DWT is applied on these three consecutive frames as shown in Figure 4.

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

The two level DWT is applied using Haar transform to obtain three LL2 (second level) frames. The temporal difference is performed between current frame with previous and next frame to obtain binary images using a threshold value. The two binary images are added to obtain a single binary image on which the morphological operation is performed.

2. Gaussian Mixture Model

GMM is used for identifying the foreground objects from background. This technique identifies the background and the foreground objects. GMM is used to extract the features in a biometric system, such as speed or color based tracking or motion of an object .

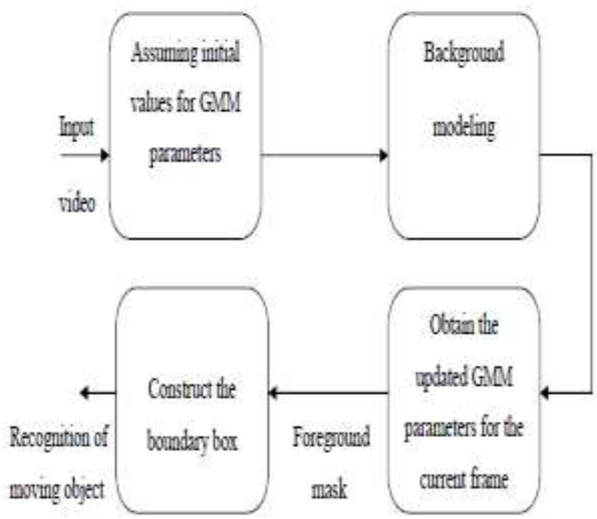


Figure 5: Block diagram of implementation of motion detection using GMM

Figure 5 shows the implementation of the moving object detection using GMM. Initially we need to assume the GMM parameters like number of Gaussians, number of training frames, variance, standard deviation and learning rate. In the next phase, we need to train the algorithm with background by considering first few frames from the video called as number of training frames.

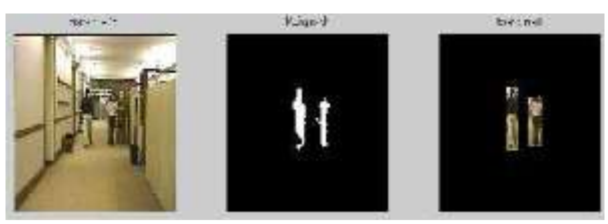
The first few frames which are used for background training should not contain any of the moving objects.

IV. SIMULATION RESULTS

Figure 6 shows the output of DWT for multiple motion detection in a video. The figure also shows the motion of an object detected in four different frames i.e. frame no 9, 77, 180 and 299, along with the original frame and foreground mask frame. The frame number 9 does not consist of any moving object, so this frame is purely a background frame.

(a)

(b)

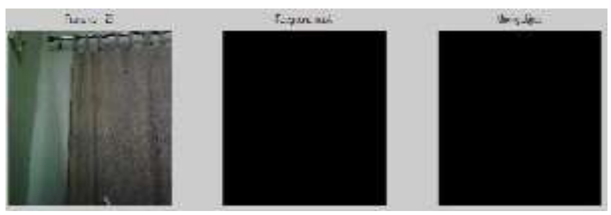


(c)

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

(d)

Figure 6: Motion detection using discrete wavelet transform obtained for: (a) frame no: 9, (b) frame no: 77, (c) frame no: 180 , (d) frame no: 299



(a)

(b)

Figure 7: Real time motion detection using GMM: (a) Background, (b) foreground Detection

3. PERFORMANCE ANALYSIS

The performance analysis in terms of precision, recall and accuracy can be measured using the ground truth images of the video sequences [6]. Ground truth image is a human segmented

ISSN: 2348 9510

International Journal Of Core Engineering & Management (IJCEM)

Volume 3, Issue 1, April 2016

binary image, where the person extracts the moving object from each frame of an video by editing. These images form a data set stored in database, which can be further used to compare, develop and optimize image segmentation algorithms. By performing the comparison between the ground truth images in the database with the detected moving objects for each frame using any of the moving object detection techniques, we can define the performance parameters.

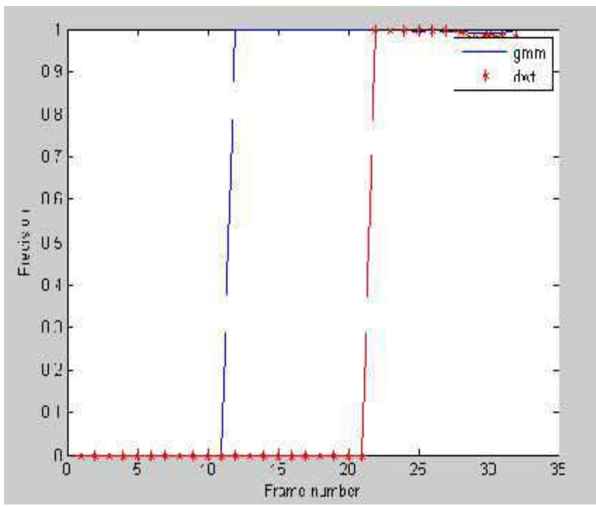


Figure 8: Plot for precision versus frame number

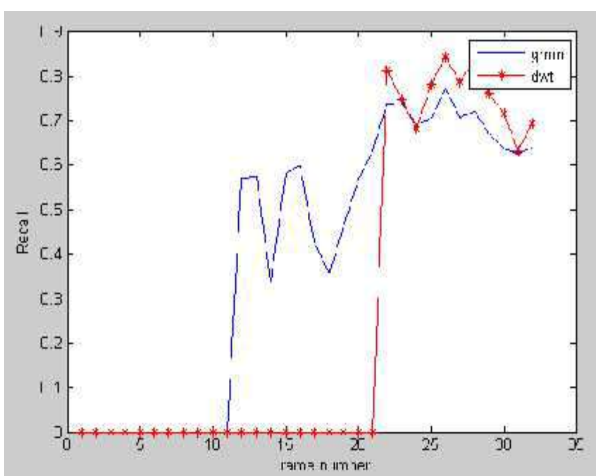


Figure 9: Plot for recall versus frame number

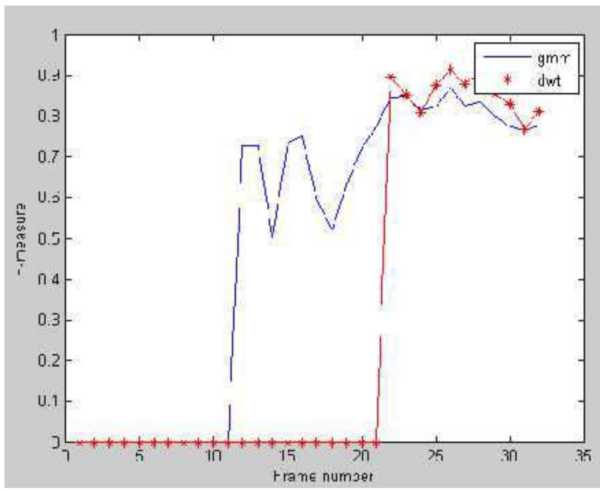


Figure 10: Plot for F-measure versus frame number

Figure 8 shows the precision, Figure 9 plots the recall and Figure 10 is the F measure obtained from DWT and GMM algorithms for moving object detection. From all these figures, we can conclude that the DWT gives better result compare to GMM. In all the three figures the x-axis shows the frame number.

V. CONCLUSION

Motion of an object is divided into two types i.e. motion of interesting object(such as person) and uninteresting object (such as cluttered). In this project, two approaches are used to create a foreground mask for the detection of moving object. The two approaches used are Discrete Wavelet Transform (DWT) and Gaussian Mixture Model (GMM). The foreground mask is used to crop the motion region from the image. By performing number of iterations using EM step, we

ISSN: 2348 9510
International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016
can segment the pixels into background and foreground. From the simulation results obtained for real time applications, we can conclude that the DWT is more efficient than GMM in terms of performance and accuracy.

REFERENCES

[1] Sanjeev Singla and Abhilasha Jain, "Improved 2-D DWT Image Compression Using Optimal Value'', International Journal of Agriculture Innovations and Research, volume 2, May 2013.
[2] D. Hari Hara Santhosh, P. Venkatesh, P.Poornesh, L.Narayana Rao and N. Arun Kumar, "Tracking Multiple Moving Objects Using Gaussian Mixture Model", International Journal of Soft Computing and Engineering, volume 3, May 2013.
[3] Widyawan, Muhammad Ihsan Zul and Lukito Edi Nugroho, "Adaptive Motion Detection Algorithm Using Frame Differences and Dynamic Template Matching Method", International Conference on Ubiquitous Robots and Ambient Intelligence, November 2012.
[4] Ms. Sonam malik and Mr. Vikram Verma, "Comparative Analysis of DWT, Haar and Daubechies Wavelet for Image Compression", International Journal of Applied Engineering Research, volume 7, no.11, 2012.
[5] Chih Hsien Hsia, Jen Shiun Chiang and Jing Ming Guo, "Multiple Moving Objects Detection and Tracking Using DWT", INTECH Open Access Publisher, Chapter 15, pp. 297-320, September 2011.
[6] David M.W. Powers, "Evaluation from Precision, Recall and F-measure to ROC, Informedness, Markedness and Correlation", Journal of Machine Language, volume 2, pp. 37-63, December 2007.
[7] D. Lee, "Effective Gaussian Mixture Learning for Video Background Subtraction", IEEE Transaction Pattern Analysis Machine Intell, volume 27, no. 5, pp. 827-832, May 2005.

ISSN: 2348 9510

International Journal Of Core Engineering & Management (IJCEM)
Volume 3, Issue 1, April 2016

[8] P. Kaew Trakul Pong and R. Bowden, "An Improved Adaptive Background Mixture Model for Real-Time Tracking with Shadow Detection", In Proceedings of European Workshop Advanced Video Based Surveillance Systems, September 2001.

[9] Dempster, N. Laird and D. Rubin, "Maximum Likelihood Estimation from Incomplete Data via the EM Algorithm", Journal of the Royal Statistic Society, volume 39, pp. 1-38, 1977.