VIDEO OBJECT TRACKING, CLASSIFICATION AND SEGMENTATION IN COMPLEX WAVELET DOMAIN

Abstract of the Thesis submitted to the

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1.1. Motivation

Recent advances in digital imaging technology, computational speed, storage capacity, continuous increase in computational capabilities of hardware at low cost, and networking have made it possible to capture, manipulate, store, and transmit images and videos at interactive speed with equipments available at home or business. As a result, images and videos are now becoming an integral part of our day-to-day life, and are being used for entertainment, education, medicine, security, science and a number of other applications. Computer vision aims to provide description, understanding and interpretation of a scene by extracting the image features. There are a number of computer vision applications, which are used to multitude of problems. For example, in medical imaging, tumor detection, measurement of size and shape of internal organs etc. In forensics, it is desired that identity of a person would be ensured. In intelligent video surveillance, it is highly desirable that an intruder can be tracked and recognized. There are other important applications too like industrial automation, radar imaging, remote sensing, robotics, etc. Now-a-days research activities are getting focused on development of intelligent video surveillance system with advances in computer vision methodology and processing capabilities. After terrorist attacks on 9/11 in USA, and that on 26/11 in Mumbai, India, a strong need for improvement in existing video surveillance capabilities was realized by the security establishments across the globe to prevent any such further terrorist attacks. Therefore, challenges and problems associated with development of intelligent video surveillance system need to be addressed. These challenges and problems motivated me to attempt four different problems namely – segmentation of moving objects, detection and removal of shadow from object, classification of object and tracking of moving objects in my thesis.

1.2. Introduction

This thesis deals with four different problems namely – moving object segmentation, shadow detection and removal, object classification and video object tracking, of intelligent video surveillance system. Intelligent video surveillance applications extract important features from video data, which provide a description, interpretation, or understanding of scene. The usual input to a surveillance system is a temporal image sequence with a corresponding amount of processed data.

The wavelet based algorithms have been successfully used in different image and video processing tasks in last few decades. The two milestone papers in late 1980's by Mallat and Daubechies have established baseline for applications of wavelet techniques. The wavelet transform is a powerful tool because wavelet representation is capable to illustrate both transient and stationary behavior of images with few wavelet coefficients. Discontinuities in an image often carry relevant information of image, and, therefore, they represent a critical part to be analyzed. Another advantage of the wavelet transform is its efficiency in representing the natural images, as only few wavelet coefficients are sufficient to represent a natural image in an effective manner. Many authors have reported work on different applications in wavelet domain, but these methods are based on real valued wavelet transform, wherein the value of wavelet filters and computed wavelet coefficients take real values. Although real valued wavelet transform based methods have provided good results, and are efficient for detecting the isotropic objects at different scales, the real-valued wavelet transforms are not optimal for detection of anisotropic objects in images (e.g. lines, contours, etc.). A real valued wavelet transform suffers from three serious drawbacks: (i) it is shift-sensitive in nature, (ii) it is having poor directional selectivity, and (iii) it provides no phase information. Due to these drawbacks real-valued wavelet transform is not suitable for video applications, because in video, the object may be present in translated and rotated form in different frames of the video and coefficients of real valued wavelet transform corresponding to object region change abruptly across different frames due to its shift variant nature.

Complex wavelet transform can reduce the above mentioned shortcomings of real-valued wavelet transform. Complex wavelet transform has not been explored to its potential. From the implementation point of view, complex wavelet transform can be implemented in different ways. Kingsbury introduced Dual tree implementation of complex wavelet transform, which is not a complex wavelet transform in true sense. Lawton and Lina have proposed complex Daubechies wavelet transform, which is a natural extension of real Daubechies wavelet transform and is found useful in certain image and video applications.

Moving object segmentation is an important step for development of any intelligent video surveillance system. Segmentation of moving object is a process of isolating the foreground object from background of a video sequence. Due to dynamic environmental conditions such as illumination variations, changing background, abrupt motion of object,

and presence of shadow, moving object segmentation is a difficult and complicated task. As compared to the number of literature available on image segmentation, very limited literature is available on moving object segmentation. Commonly used techniques for moving object segmentation are background segmentation, statistical models, temporal differencing, and optical flow. Most of the work on moving object segmentation have been done using spatial domain techniques, which suffer from problem of either inaccurate segmentation due to non-removal of noise or failure to detect new appearance automatically. Real valued wavelet transform based moving object segmentation methods have been proposed to reduce the problems of spatial domain techniques. But as we have mentioned in preceding paragraph that real valued wavelet transform is not suitable for video applications, therefore successful exploitation of complex wavelet transform might reduce the different complicated tasks of moving object segmentation problem.

Detection and removal of shadow is a challenging problem. Presence of shadow degrades performance of any surveillance system as a number of shadow points are always misclassified as object points. The real challenge is to distinguish between object and its shadow in a video as they share same motion features. The objectives of shadow detection and removal is to locate shadow regions to distinguish shadow from the foreground object and to remove shadow from scene. Several shadow detection algorithms are available in literature for still image, whereas, works reported on shadow detection in moving object are limited. Several algorithms exist to differentiate between moving object and its shadow. Out of these, some algorithms fail to give accurate results in various lighting and environmental conditions whereas others are not able to detect shadow accurately. Most of the approaches for shadow detection and removal in moving object are in non-wavelet domain. Therefore, there is a strong need to develop algorithms in wavelet domain for detection and removal of shadow accurately.

The objective of object classification is to classify an object which is member of a given set of abstract classes into one such abstract class. Object classification has several applications in areas like tracking of moving objects in video sequence, object recognition, surveillance, medical imaging etc. Problems of object classification poses different challenges in different applications. Object classification algorithm should be accurate in medical imaging application, whereas in surveillance system, the object classification algorithm needs to take into account real-time constraints and should be robust in the sense that it should be capable to handle color and pattern of human garments, varying

lighting conditions. Classification of objects in multiple classes is a challenging task because of its highly computation intensive nature. Many techniques are available in literature for classification of objects in two classes, but only limited works have been reported for multi-class object classification. Correctness of any classification scheme lies on selected feature, therefore selection of effective feature is a crucial step for successful classification, and the requirement is to develop an object classification algorithm using proper features.

Video object tracking is a problem of estimating the position and other relevant information of moving objects in each frame of video. Video object tracking has received considerable attention by the research community in past decade, mainly due to wide range of its potential applications. Main challenges of video object tracking are to deal with varying object size and shape, changing background, partial or full occlusion etc. Most difficult challenge in reliable tracking is to associate target locations in consecutive frames of video, especially when the objects are moving fast relative to frame rate. There are two approaches for tracking: one is prediction based and other one is detection based. Prediction based tracking is useful for single object tracking whereas detection based tracking is useful in tracking of multiple objects. In prediction based tracking, prediction of object positions can be made on basis of object features, and object movement information such as speed of object, direction of movement etc. In detection based tracking, detection of objects is essential in every frame for tracking of objects. Inaccurate detection of objects leads to failure in multiple object tracking, therefore, multiple object tracking is much more complicated task than single object tracking.

1.3. Thesis Objectives

The objective of the proposed work in this thesis is to apply complex wavelet transform on images as well as on videos for different problems viz. moving object segmentation, shadow detection and removal, object classification and video object tracking. Direction of this research will lead to development of some efficient complex wavelet transform based algorithms for different applications of intelligent video surveillance.

The objectives of this thesis are as follows:

(i) To design a new and efficient algorithm for moving object segmentation using complex wavelet transform, and exploit the properties of complex wavelet

transform, which makes the algorithm to work not only in case of normal video but also in case of noisy video, video with non-stationary background and poor contrast video.

(ii) To design new and efficient algorithm for detection and removal of shadow of objects in video using complex wavelet transform.

(iii) To design new and efficient algorithm for multi-class classification using complex wavelet transform and to combine the Zernike moment to make algorithm more efficient.

(iv) To design new and efficient algorithms for single object tracking and for multi object tracking, in video sequence, using combination of complex wavelet transform and Zernike moment.

1.4. Development of the Thesis

Focus of this thesis is to develop some efficient complex wavelet based methods for different applications of intelligent video surveillance. The developed methods should be robust, as much as possible in different object appearances and in complex environment. Different wavelet based techniques have been successfully applied in various image and video processing applications, namely segmentation, classification and motion estimation. The real valued wavelet transform provides a fast, local, sparse, multi-resolution analysis of the image and video. Although, it is a powerful tool for image and video processing, it has three serious disadvantages: shift sensitivity, poor directionality, and lack of phase information. To avoid these shortcomings, the Daubechies complex wavelet transform has been used. It is an extension of Daubechies real valued wavelet transform in the complex domain. The Daubechies complex wavelet can be made symmetric, thus leading to symmetric Daubechies complex wavelet transform, and thus it become more useful for image and video processing applications. In this thesis, novel solutions to the moving object segmentation, shadow detection and removal, object classification and video object tracking problems are performed which are briefly described as below-

1.4.1. Moving Object Segmentation

Two methods for segmentation of moving objects using Daubechies complex wavelet transform are proposed. First one is based on single change detection method, and then second method based on double change detection method is an extension of the first one wherein three consecutive frames are taken into account as compared to two consecutive frames for segmentation of moving object. Daubechies complex wavelet transform shows approximate shift invariance and better directional selectivity as compared to real valued wavelet transform. The reduced shift sensitivity and rotation invariance properties of Daubechies complex wavelet transform makes the method more suitable for segmentation of moving object. Changed detection methods (single change detection and double change detection) have been chosen as they provide automatic detection of appearance of new objects. The results after segmentation of moving object using the proposed method have been compared qualitatively as well as quantitatively with other state-of-the-art methods. For quantitative performance eight different performance metrics viz. Average difference, Structural content, Normalized absolute error, Misclassification penalty, Percentage of correct classification, Pixel classification based measure, Relative foreground area measure, and Relative position based measure have been used. From experimental results it has been found that the proposed method perform better over other state-of-the-art methods.

Highlights of this work, can be summarized as follows –

(i) A new method for moving object segmentation which is based on change detection method using Daubechies complex wavelet transform coefficients is developed.

(ii) This method needs no manual intervention and needs only values of Daubechies complex wavelet transform coefficients.

(iii) The proposed method has been tested for several video sequences and is found to have better performance as compared to other representative state-of-the-art methods.

1.4.2. Shadow Detection and Removal

A new method for detection and removal of shadow from moving object using Daubechies complex wavelet transform has been proposed in this thesis. Edge detection, approximate shift invariance, and approximate rotation invariance properties of

Daubechies complex wavelet transform makes the method more suitable for shadow detection and removal and allows user to detect shadow from moving object. In the proposed method, coefficient of variation (relative standard deviation) is used as a new threshold because it is more informative and more consistent than other thresholds such as standard deviation. This threshold is automatically determined and does not require any supervised learning or manual calibration. The proposed method is flexible and does not depend on any other parameter except complex wavelet coefficients. The results after shadow detection and removal from moving objects using the proposed method have been compared qualitatively and quantitatively. Three different performance metrics have been used for quantitative evaluation viz. shadow detection rate, shadow discrimination rate and paired t-test. The proposed method has been evaluated on a number of video sequences, and it has been found that the proposed method performs better over other state-of-the-art methods.

Contributions of this work, can be summarized as follows:

(i) A method for shadow detection and removal from moving object which is based on Daubechies complex wavelet transform has been presented.

(ii) Coefficient of variation is used as a new threshold because it is more informative and more consistent.

(iii) The threshold is automatically determined and does not require any supervised learning or manual calibration.

(iv) The proposed method does not depend on any other parameter except complex wavelet coefficients.

(v) The proposed method has been evaluated for a number of video sequences and is found to have better performance in terms of a three performance metrics (shadow detection rate, shadow discrimination rate and paired *t*-test) as compared to representative state-of-the-art methods.

(vi) The proposed method performs well for, both, indoor and outdoor types of video sequences.

1.4.3. Object Classification

In this work, an object classification method for two-class classification has been proposed which is further extended for multi-class classification. The proposed method is based on combination of two features namely Daubechies complex wavelet transform and

Zernike moments and is independent of any other spatial features such as color, shape, edges, etc. In case of two-class object classification, Support vector machine classifier and Adaboost classifier have been used separately to classify object of a scene into one of the two classes: human object and non-human object. In case of multi-class object classification, multiclass Support vector machine has been used as a classifier to classify the object of a scene into one of seven classes: Human, Motorbike, Car, Aeroplane, Dog, Bicycle and Negative objects (objects other than the classes, Human, Motorbike, Car, Aeroplane, Dog, Bicycle). Experiments have been performed with the proposed method using discrete wavelet transform and dual tree complex wavelet transform as features. The results after classification of objects by using the proposed method have been compared with other state-of-the-art methods. From all experimental results of object classification and their critical analysis, it has been concluded that the proposed method based on combination of Daubechies complex wavelet transform and Zernike moment performs well over other state-of-the-art methods.

Contributions of this work, can be summarized as follows:

(i) A new method for object classification is presented, which is based on combination of Daubechies complex wavelet transform and Zernike moment as a feature of object.

(ii) The proposed method does not depend on any parameter except Zernike moments of Daubechies complex wavelet transform coefficients.

(iii) The proposed method is able to classify the objects, with frontal as well as side views of objects.

(iv) A new dataset, has been created for evaluation of multi-class classification, which contains seven classes: Human, Motorbike, Car, Aeroplane, Dog, Bicycle and Negative objects (objects other than the classes Human, Motorbike, Car, Aeroplane, Dog, Bicycle).

(v) The proposed method is able to classify the objects with cluttered background, varying lighting conditions, etc.

1.4.4. Video Object Tracking

In this work, useful properties of Daubechies complex wavelet transform and Zernike moment, for object tracking in video sequence has been exploited. Two different

algorithms for object tracking, first one for single object tracking and second one for multiple object tracking have been proposed. Algorithms for single object tracking and multiple object tracking, both, uses combination of Daubechies complex wavelet transform and Zernike moment as a feature of object. Reduced shift sensitivity and better edge representation properties of Daubechies complex wavelet transform alongwith rotation invariance property of Zernike moment make proposed methods suitable for tracking of single as well as multiple objects. The proposed algorithms are simple to implement since they do not need any other parameter except the Zernike moment coefficients of Daubechies complex wavelet transform coefficients.

Contributions of this work, can be summarized as follows:

(i) A new method for tracking of object in video, which is based on combination of Daubechies complex wavelet transform and Zernike moment as a feature of object, is developed and presented.

(ii) The proposed method depends only on value of Zernike moments of Daubechies complex wavelet transform coefficients.

(iii) The proposed method is able to track object efficiently where objects are moving at fast speed and direction of movement changes abruptly.

(iv) The proposed method needs least manual intervention.

(v) The proposed method is able to track the objects in the video having cluttered background, poor contrast as well as changing lighting conditions.

(vi) The proposed method is able to handle different object tracking problems such as partial/full occlusion, re-entering of object in scene, etc.

(vii) The proposed method has been tested on several video sequences and is found to have better qualitative and quantitative performance as compared to representative state-of-the-art methods.

1.5. Organization of the Thesis

This thesis consists of eight chapters. Outline of the thesis is as follows:

Chapter 1 presents a brief introduction of the problems addressed in this thesis followed by the objectives of the thesis. Finally chapter concludes with a brief account on contributions of this thesis in field of image/video processing.

Chapter 2, presents an introduction of wavelet transform, followed by drawbacks of real valued wavelet transform, and investigation of the construction method of Daubechies complex wavelet transform. This chapter explores properties of Daubechies complex wavelet transform, which provide basic framework for different problems addressed in subsequent chapters. This chapter also provides a basic introduction of new generation wavelet transforms such as curvelet transform and contourlet transform with their useful properties.

Investigation of moments, types of moments, moment invariants, and properties of moments are discussed in Chapter 3. This chapter explores Zernike moment and its useful properties with respect to the problems addressed in this thesis.

Chapter 4 presents a new method for moving object segmentation using complex wavelet transform. In this chapter we have proposed change detection based object segmentation method. Usefulness of complex wavelet transform for segmentation has been discussed in this chapter. The proposed method and other state-of-the-art methods have been tested on different types of videos viz. normal video, noisy video, non-stationary background video and low quality with poor contrast video. Quantitative performance of the proposed method has been evaluated and compared with other state-of-the-art methods in terms of different performance metrics viz. average difference, structural content, normalized absolute error, misclassification penalty, percentage of correct classification, pixel classification based measure, relative foreground area measure and relative position based measure.

Chapter 5 presents a method based on complex wavelet transform for detection and removal of shadow of object in video. This chapter presents a new threshold for shadow detection and removal. Robustness of the proposed method in comparison to other state-of-the-art methods has been tested for different types of videos. Finally, the quantitative performance values for different cases have been computed for the proposed method and other state-of-the-art methods and then compared in terms of three performance evaluation metrics viz. shadow detection rate, shadow discrimination rate, and paired t-test.

The problem of object classification is addressed in Chapter 6 of thesis. In this chapter, first we discussed two-class object classification and then extended it to multi-class object classification. We have proposed a method for two-class classification and multi-class classification using complex wavelet transform. Further, the method is extended to combine complex wavelet transform with Zernike moment. Performance of

the proposed method has been analyzed in terms of confusion matrix, true positive rate, true negative rate, false positive rate, false negative rate, predicted positive rate and average classification accuracy.

Chapter 7 presents a method for object tracking in video sequence. In this chapter we have discussed single object tracking and multi-object tracking methods. In case of single object tracking, we have used energy of Zernike moments of Daubechies complex wavelet transform. A critical analysis of the single object tracking results using the proposed method and other state-of-the-art methods has been done and discussed in this chapter. For performance evaluation of single object tracking method, we have used different measures like centroid position, Euclidean distance, Mahalanobis distance, and Bhattacharya distance. For case of multiple object tracking, we present a new framework using combination of Daubechies complex wavelet transform and Zernike moment. The experimental results for multiple objects tracking of the proposed method are presented in this chapter.

Chapter 8 presents conclusions of the thesis and summarizes main findings of this thesis work. This chapter also proposes some possible future perspectives of the thesis.

1.6. Contributions of the Thesis

This section describes the important contributions of the thesis in field of image/video processing, as follows:

(i) We have exploited different properties of complex wavelet transform, and demonstrated their suitability and application to solve different problems such as: moving object segmentation, detection and removal of shadow from object in video, object classification, and video object tracking.

(ii) We have exploited different properties of Zernike moment, and demonstrated their suitability to solve object classification and video object tracking.

(iii) A new method for segmentation of moving object in complex wavelet domain is proposed. The proposed algorithm is capable to segment the moving object for normal video, noisy video as well as for non-stationary background video.

(iv) A new method for detection and removal of shadow from object in video using complex wavelet transform has been proposed.

(v) We have explored new threshold in form of coefficient of variation for detection and removal of shadow.

(vi) A new method for object classification has been proposed. The proposed method is based on complex wavelet transform and Zernike moment.

(vii) Two new methods for single object tracking and multiple object tracking are proposed, which are based on combination of complex wavelet transform and Zernike moment.

1.7. Publications

Published / Accepted Papers in International Journals

1. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Object Tracking using combination of Daubechies complex wavelet transform and Zernike moment", Accepted with revision, *Multimedia Tools and Applications*, Springer, 2014.
2. **Manish Khare**, Nguyen Thanh Binh, Rajneesh Kumar Srivastava, "Human Object Classification using Dual tree complex wavelet transform and Zernike moment", Accepted, *LNCS Transaction on Large Scale Data and Knowledge Centered System*, Springer, 2014.
3. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Moving Shadow Detection and Removal - A Wavelet Transform based Approach", Accepted, *IET Computer Vision*, IET Publication, 2014. [doi: 10.1049/iet-cvi.2014.0028].
4. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Moving Object Segmentation in Daubechies Complex Wavelet Domain", Accepted, *Signal Image and Video Processing*, Springer, 2013. [doi: 10.1007/s11760-013-0496-4].
5. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Single change detection-based moving object segmentation by using Daubechies complex wavelet transform", *IET Image Processing*, Vol. 8, No. 6, pp. 334-344, 2014.
6. Alok Kumar Singh Kushwaha, Chandra Mani Sharma, **Manish Khare**, Om Prakash and Ashish Khare, "Adaptive real-time motion segmentation technique based on statistical background model", *The Imaging Science Journal*, Vol. 62, No. 5, pp. 285-302, 2014.
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8. **Manish Khare**, Rajneesh Kumar Srivastava, "Level set method for segmentation of medical images without reinitialization", *Journal of Medical Imaging and Health Informatics*, Vol. 2, No. 2, pp. 158-167, 2012.

Communicated Papers in International Journal

9. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare: "On Tracking of Multi human objects using Combination of Daubechies complex wavelet transform and Zernike moment", Communicated for publication in *Multimedia Systems*, Springer.

Book Chapter Publication

10. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Daubechies Complex Wavelet Based Computer Vision Applications", in *Recent Developments in Biometrics and Video Processing Techniques* (Eds. R. Srivastava, S. K. Singh and K. K. Shukla), Chapter 7, pp. 138-155, 2013, IGI Global. [doi:10.4018/978-1-4666-4868-5.ch007]

Published / Accepted Papers in Conference Proceeding

11. **Manish Khare**, Nguyen Thanh Binh, Rajneesh Kumar Srivastava, Ashish Khare, "Vehicle Identification in Traffic Surveillance - Complex Wavelet Transform based Approach", Accepted in *International Conference on Advanced Computing and Applications (ACOMP2014)*, 19-21 November, 2014, Ho Chi Minh City, Vietnam.
12. Om Prakash, **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Tracking of deformable object in complex video using steerable pyramid wavelet transform", *in proceeding of 5th International Conference on Computational Vision and Robotics (ICCVR 2014)*, 9-10 August, 2014, Bhubaneswar, India.
13. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Dual tree complex wavelet transform based Shadow Detection and Removal from Moving Objects", *in proceeding of 26th SPIE Electronic Imaging, Vol. 9029 (Visual Information Processing and Communication V)*, pp. 90290D (1-7), 02-06 February, 2014, San Francisco, USA [doi:10.1117/12.2042453].

14. Om Prakash, **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Multiclass Image Classification Using Multiscale Biorthogonal Wavelet Transform", *in proceeding of 2nd IEEE International Conference on Image Information Processing (ICIIP 2013)*, pp.131-135, 09-11 December, 2013, Shimla, India.

15. Ashish Khare, **Manish Khare**, Rajneesh Kumar Srivastava, "Dual tree complex wavelet transform based Multiclass object classification", *in proceeding of 12th International Conference on Machine Learning and Applications (ICMLA 2013)*, pp. 501-506, 04-07 December, 2013, Miami, Florida, USA.

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18. **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, Moongu Jeon, "Curvelet Transform based Moving Object Segmentation", *in proceeding of 20th IEEE International Conference on Image Processing (ICIP 2013)*, pp. 4079-4083, 15-18 September, 2013, Melbourne, Australia.

19. **Manish Khare**, Alok Kumar Singh Kushwaha, Rajneesh Kumar Srivastava, Ashish Khare, "An Approach towards wavelet transform based multiclass object classification", *in proceeding of IEEE 6th International Conference on Contemporary Computing (IC3 2013)*, pp. 365-368, 8-10 August, 2013, Noida, India.

20. **Manish Khare**, Swati Nigam, Rajneesh Kumar Srivastava, Ashish Khare, "Contourlet Transform Based Moving Object Segmentation", *in proceeding of IEEE International Conference on Information and Communication Technologies (ICT 2013)*, pp. 782-787, 11-12 April, 2013, Kanyakumari, India.

21. Swati Nigam, **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "An Effective Local Feature Descriptor for Object Detection in Real Scenes", *in proceeding of IEEE International Conference on Information and Communication Technologies (ICT 2013)*, pp. 244-248, 11-12 April, 2013, Kanyakumari, India.

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23. Alok Kumar Singh Kushwaha, Chandra Mani Sharma, **Manish Khare**, Rajneesh Kumar Srivastava, Ashish Khare, "Automatic Multiple Human Detection and Tracking for Visual Surveillance System", *in proceeding of IEEE/OSA/IAPR International Conference on Informatics, Electronics and Vision (ICIEV 2012)*, pp. 326-331, May 18-19, 2012, Dhaka, Bangladesh.