Chapter 7 : CONCLUSION AND FUTURE WORK

The conclusions of work of this thesis and suggestions for future research are presented in this chapter.

7.1. Conclusions

Enabling computers to understand images and videos of real scenario is a crucial step towards development of any intelligent video surveillance system. Intelligent video surveillance has vast applications which includes transport applications (such as monitoring of railway station, airport, traffic control etc.), industrial applications (such as monitoring different industry plants), and security applications (such as monitoring of indoor and outdoor environments, monitoring of people in different places etc.).

Focus of this thesis is to develop some efficient algorithms for different applications of intelligent video surveillance. The developed methods should be robust as much as possible with appearance of different objects in complex environments. In this thesis, novel methods for moving object segmentation in complex wavelet domain, background modelling & shadow suppression in complex wavelet domain, and finally multi-view human activity recognition, are proposed followed by their testing and evaluation as compared to other representative state-of-the-art methods.

Chapter 1 discussed the motivation, background and problem description for the presented work including thesis scope/objectives, and contributions.

Chapter 2 discussed the theoretical background for video surveillance system. In this chapter, we have also given an overview of complex wavelet transform. Further, in this chapter a literature survey of prominent approaches for moving object segmentation and activity recognition are given.

Chapter 3 presented a review and experimental study of various recent moving object segmentation methods available in literature and these methods were classified into four

categories i.e. moving object segmentation methods based on (i) motion information (ii) motion and spatial information (iii) learning, and (iv) change detection. The objective of this chapter was two-fold i.e. firstly, this chapter presented a comprehensive literature review and comparative study of various classical as well as state-of-the art methods for moving object segmentation under varying illumination conditions. Further, in this chapter, an efficient approach for moving object segmentation under varying illumination conditions was proposed and its comparative study with other methods under consideration was presented. The qualitative and quantitative comparative study of the various methods under four categories as well as the proposed method was presented for six different datasets.

In chapter 4, two new methods for dynamic background modeling and shadow suppression using Daubechies complex wavelet transform have been presented. First method handles the small movements of non-static objects such as tree branches and bushes blowing in the wind, waving trees, shadow regions that are projected by foreground objects and are detected as moving objects. Second method deals with highly dynamic background such as moving object in water surface, boat wakes, and weather issues (such as bright sun, fog, heavy rain), moving object in rain fall, and maritime object detection in night. It was concluded that the proposed methods using Daubechies complex wavelet transform performs better visually as well as quantitatively, 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 different performance evaluation metrics.

Chapter 5 deals with problem of human activity recognition. In this chapter, a multi-view human activity recognition system based on spatio-temporal template is proposed.

Performance of this method has been analyzed in terms of confusion matrix and recognition accuracy.

Chapter 6, deals with problem of multi-view activity recognition for multiple human. The proposed methods are based on combination of two features, namely, Contour based distance signal feature and Uniform rotation local binary patterns. Experimental results indicate that the proposed methods perform well for both single human activity and multiple human activity. Performance of the proposed method has been analyzed in terms of confusion matrix and recognition accuracy.

Finally, the overall conclusion of this thesis is being summarized as follows:

- Investigated and presented a comprehensive literature review and comparative study of various classical as well as state-of-the art methods for moving object segmentation under varying illumination conditions. Further, a new method for moving object segmentation which is based on improved approximate median filter using Daubechies complex wavelet transform coefficients was developed. The proposed method had been tested for several video sequences and was found to have better performance as compared to other representative state-of-the-art methods.
- Developed and implemented two new methods for dynamic background modelling and shadow suppression in Daubechies complex wavelet domain were proposed. First method handles the small movements of non-static objects such as tree branches and bushes blowing in the wind, waving trees, shadow regions that are projected by foreground objects, and are detected as moving objects. Second method deals with highly dynamic background such as moving object in water surface, boat wakes, and weather issues (such as bright sun, fog,

heavy rain), moving object in rain fall, and maritime object detection during night time.

- A new method for multi-view human activity in video, which is based on motion history images and spatial pose information, was developed and presented. The proposed method was suitable for static activities (like sitting, sleeping, standing, bending) as well as for dynamic activities (like jogging, walking). The proposed method was found better in terms of all visual as well as quantitative performance metrics as compared to other methods.
- Design and Development of a new method for multiple human activities in multiple-view, which is based on combination on two features, namely, Contour based distance signal feature and Uniform rotation local binary patterns. The proposed method was suitable for multiple human activities in multi-view direction. The proposed method is found better in terms of all visual as well as quantitative performance metrics as compared to other methods.

7.2. Suggestions for Future Research

The research work presented in this thesis can be taken further into different directions. The scope for future works is as follows:

Segmentation of moving objects in unconstrained videos, for example video obtained from the broadcast news network or home video, is very difficult. These videos are compressed, unstructured and typically contains the edited clips acquired by moving cameras from multiple views. So, there is scope for development of segmentation algorithm that could handle such type of videos. Recently a 3D dual tree complex wavelet transform [181, 182] has been developed, and claims that this transform would be more suitable for video applications. This work points to clear possibility use of the same 3D dual tree complex wavelet transform for segmentation of moving object in future.

Human activity recognition in video is a problem which has applications in several areas. The proposed method for multi-view human activity recognition is a new approach and tested for only a selected set of comparatively less complex videos, seems to perform, well. Still, there is scope to make it more robust and accurate for activity recognition in more realistic and complex videos. 3-D videos are getting more and more popular, they make the problem of human activity recognition even more complex as compared to that for 2-D videos and would need new methods in future for activity recognition in 3D videos .