

Chapter 5

5 Conclusions and Future Scope

This thesis has been proposed with the aim of developing a low cost software model for object identification and to carry out the estimation of motion analysis of the object. Because of the fact that there is not yet an outperforming algorithm, even though the literature on object tracking is very rich, various approaches are merged together for achieving better results. Different approaches have been tried for different tasks during the development of the new proposed algorithms implemented and discussed in the previous chapters.

Discrete Wavelet Transform was implemented for object identification initially, but during literature survey it was found to be superseded by Discrete Curvelet Transform and Discrete Contourlet Transform. For Visual tracking, Digital Signature algorithm has been tried for region matching. But the approach has not been extended further as it was not able to handle the shape variations. Scale Invariable Feature Transform (SIFT) could not be implemented, as it required heavy texture of the object. Gradient Vector Force (GVF) snake algorithm also has been tried, but could not handle the tracking, as it needs good initialization parameters close to the object boundaries in order to segment the objects. Another disadvantage of GVF tracking is the risk of error propagation, due to wrong detected segments which is used for initialization in the next frame. Kalman Filtering is not implemented due to the requirement of model

parameters for each moving object. Finally Hybrid tracker based on Color histogram and discrete Contourlet Transform has been proposed.

To conclude this section, it is interesting to enumerate the advantages and disadvantages of the proposed algorithm.

5.1 Conclusions

The visual tracking algorithm for multiple object tracking based on Contourlet transform works more efficiently than the standard blob tracking method which is based on area and Centroid of the object. We introduced tracking method based on the 3D color histogram for color feature extraction and tracking the region. Region matching has been carried out using 2D seven invariant moments calculated from the histogram, which needs to match only seven descriptors of each region. So the execution time taken by the algorithm is less than the conventional matching methods. Also to overcome the problem of same color descriptor region, feature extraction using Contourlet transform has been introduced effectively. Algorithm uses multiple methods for tracking the object in efficient way, which can handle the color features as well as edge point features.

The visual tracking algorithm for multiple object tracking based on the color features and Contourlet transform are more efficient than the conventional methods. The proposed algorithm has been implemented embedding more challenges. The algorithm can handle the object tracking of varying size. General aperture problems which occur due to the motion of camera or light reflection from the surface can be handled by pre processing techniques. The method has no restrictions such as prior object shape or motion model assumptions. Execution speed of the proposed approach is sufficient enough to be used for real time applications. It can handle partial occlusion very well. Feature extractions using Contourlet Transform can be used for object identification as well as region matching that serves the dual purpose as it saves the time for execution as well as increases the efficiency for tracking along with

identification of an object. Algorithm can well handle the shadow, variation and illumination changes due to the change in lighting conditions.

5.2 Limitations and Future Scope

Although the visual tracking algorithm proposed here is robust in many of the conditions, it can be made more robust by eliminating some of the limitations as listed below:

- In the Single Visual tracking, the size of the template remains fixed for tracking. If the size of the object reduces with the time, the background becomes more dominant than the object being tracked. In this case the object may not be tracked.
- Fully occluded object cannot be tracked and considered as a new object in the next frame.
- Foreground object extraction depends on the binary segmentation which is carried out by applying threshold techniques. So blob extraction and tracking depends on the threshold value.
- Splitting and merging cannot be handled very well in all conditions using the single camera due to the loss of information of a 3D object projection in 2D images.
- For Night time visual tracking, night vision mode should be available as an inbuilt feature in the CCTV camera.

To make the system fully automatic and also to overcome the above limitations, in future, multi- view tracking can be implemented using multiple cameras. Multi view tracking has the obvious advantage over single view tracking because of wide coverage range with different viewing angles for the objects to be tracked.

In this thesis, an effort has been made to develop an algorithm to provide the base for future applications such as listed below.

- In this research work, the object Identification and Visual Tracking has been done through the use of ordinary camera. The concept is well extendable in applications like Intelligent Robots, Automatic Guided Vehicles, Enhancement of Security Systems to detect the suspicious behaviour along with detection of weapons, identify the suspicious movements of enemies on boarders with the help of night vision cameras and many such applications.
- In the proposed method, background subtraction technique has been used that is simple and fast. This technique is applicable where there is no movement of camera. For robotic application or automated vehicle assistance system, due to the movement of camera, backgrounds are continuously changing leading to implementation of some different segmentation techniques like single Gaussian mixture or multiple Gaussian mixture models.
- Object identification task with motion estimation needs to be fast enough to be implemented for the real time system. Still there is a scope for developing faster algorithms for object identification. Such algorithms can be implemented using FPGA or CPLD for fast execution.