Abstract

In recent years, there has been an impressive enrichment in the quantity of video data which can be hoarded in volume. The availability of economical video cameras, the ever decreasing cost of digital storage space and the outbreak in reputation of video sharing from all corners, created an enormous demand for refined approaches to automatically explore and comprehend video content which in turn necessitates object tracking.

Object tracking is an important problem in the area of computer vision (CV) supported by pattern recognition (PR) and image processing (IP) approaches. Bundle of research has been conducted in the area ranging from simple applications to evolving novel algorithms applicable to complex scenes. However, a good number of explorations are centered on tracking a specific and a well defined target. In a similar way, this research endeavors to contribute more refined manners and augment the contemporary recommended strategies.

The procedure of establishing the correspondence of an interested single object or multiple objects in a progression of the video frames is object tracking. It is necessary, due to the inability of human beings to concentrate on the interested moving object in a scene of video for longer time due to natural limitations. Thus, by exploiting the computer intelligence, a bounding box is superimposed on the concerned moving object.

Generally, the moving object regions in the image are obtained and then it is the tracker’s task to perform object correspondence from one frame to the next to generate the path of the object. The system should use both fast and advanced algorithms to achieve a superior ratio between accuracy and speed. Several approaches have been proposed for object tracking which admit specific
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variations and differ with respect to the kind of video. Some strategies track objects in an intensity video and others in a range of color video. The broader area of proposing approaches are either inherited from spatial, or frequency, or hybrid domain.

The significant applications of object tracking are video surveillance, robot navigation, traffic monitoring, recognizing suspicious people, medical imaging, industrial applications, entertainment media, armed forces, law enforcement and sports etc.

In this research, experiments have been conducted on video sequences showing single or multiple objects in a static or dynamic background captured by a single camera. The robust and unified object tracking systems have been extended using IP and PR techniques.

Experiments have been performed with popular and benchmark dataset such as Ball, Sample, Performance Evaluation of Tracking and Surveillance (PETS), Video Surveillance Online Repository (VISOR), Hamburg Taxi and dtneuWinter. PETS consists of PETS2000 and PETS2001. The dataset PETS2001 has three clips like PETS2001(1), PETS2001(2) and PETS2001(3). Hence, tracking with nine benchmark dataset has been carried out to investigate the performance.

The performance of the proposed object tracking systems is evaluated by quantitative analysis using metrics such as Precision (P), Recall (R) or Detection Rate (DR) and False Alarm Rate (FAR). These metrics in turn use the quantities True Positive (TP), False Positive (FP) and False Negative (FN). Further, the refined results of tracking like Combined Result (CR), F-measure and G-measure are computed using P, R and FAR.

The prime task of object tracking is to maintain path and concentration on a particular object in video frames. The entity of the object in the sequence of video is not uniform due to various constraints such as swift alteration in velocity of object, translation, scaling, rotation, occlusion, change in illumination, appearance, camera motion, loss of content in transformation of 3D world information into 2D and perspective projection etc. In order to cope with different difficulties of object tracking, some of the novel algorithms have been intended.

This research work has offered contributions as follows. The scrutiny in this thesis has been initiated with the three routine approaches for object tracking.
Two systems of tracking the object through the background subtraction and frame differencing are implemented. The third process of tracking is accomplished by means of template matching with frame, through the Normalized Cross Correlation (NCC) score. The next proposed approaches of tracking consist of six systems based on matching between the template and exhaustive image (or partitioned image) by NCC score and different updating schemes like NCC, PCA and Histogram Regression Line (HRL) respectively. To reduce the search region for offering robust tracking systems to improve the tracking efficiency, meanshift along with Joint Histogram of Color and Color Coherence Vector (CCV) have been employed.

In an effort to get better performance, the concept of the color optical flow of Horn-Schunck or Lukas-Kanade has been adopted to obtain the moving objects. The Histogram Regression Line and Doyle’s distance are extended as respective updating methods. Therefore, the combination of the above has created four tracking systems like color optical flow of Horn-Schunck or Lukas-Kanade with HRL for updating, color optical flow of Horn-Schunck or Lukas-Kanade with Doyle’s distance for updating.

The computational aspects have been reduced to some extent by proposing another set of contributions through gray optical flow of Horn-Schunck and frequency domain based updating by the Fourier Descriptors (FD) of conventional centroid and the proposed Geometric Mean of Segmented Centroid (GMSC) distance functions.

Further, performance of the tracking is improved by proposing the systems based on classical third level DWT and Lifting based DWT (LDWT). Here, the course of updating is executed by Weighted Standard Deviation (WSD) Descriptors.

The work of this thesis has spanned through nine chapters. The first chapter presents an introduction and final chapter a formal summary with visualized scope of future avenues. The second chapter deals with verification of existing routine methods of tracking. Five diverse models have been illustrated in respective chapters and one of the chapters underlines on the painstaking comprehension of all the proposed novel methodologies for object tracking. Altogether, the outcome of this thesis has generated enthusiasm and eagerness to discover many fascinating extensions in using IP and PR criteria for tracking.