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Robust Visual Target Tracking Via Nearest Sequential Boundary Pattern

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***Abstract*— Video tracking is the modernized technology used for retrieving the target object from the frame. The representation of the target is the necessary component for a robust tracker. During the tracking process several factors make the errors significantly large, which leads to the drift in the target. This paper presents a propose a novel method for tracking the target regions from the video frame. Nearest Sequential Boundary Pattern (NSBP) is a new method used for the extraction of background and retrieval of pattern from moving object. The extracted target is used for classifying the regions from the target using the Relevant Pattern Classification (RPC) algorithm. It is used for matching the grid as the tracked region and provides the binary label for separating the background and the foreground. Then the target is tracked using the blob based extraction technique. Then the performance of the video tracking system is analyzed using several parameters such as sensitivity, specificity and accuracy.**

Keywords—Relevant Pattern Classification (RPC), Nearest Sequential Boundary Pattern (NSBP), Video tracking, Video processing

I. INTRODUCTION

An essential component in multimedia application is the video because of rich content. The development of robust tools is the challenging task in computer vision processes includes video indexing, browsing or searching. The processes such as the segmentation of foreground from the background, shadow removal and the target tracking are based on the non-changing background of surveillance area. The tracking of target in video frames is a challenging problem in computer vision because of the appearance of the target environment, illumination changes and the partial occlusions[1]. The aerial imagery is generally considered to be harder than the traditional tracking system due to the problems associated with a moving platform, which includes the gimbals based stabilization errors, and Geo-registration errors. Tracking is defined as the problem of approximating the path of an objects in the image plane as it is moving around a scene. The task of the visual tracking is to estimate the motion states of the target in successive frames by giving an initial state. The accumulated error during the learning process is the major factor, which influence the tracking performance.

A. Video Tracking

The captured video frames are converted and saved in the digital format. After the estimation of suitable target area, the segmentation process segments the target area from the original video frame. The features from the extracted target area are obtained using the feature extraction algorithm. By exploiting the extracted features, the classification algorithm classifies the video frames and identifies the object for enabling the tracking operation.

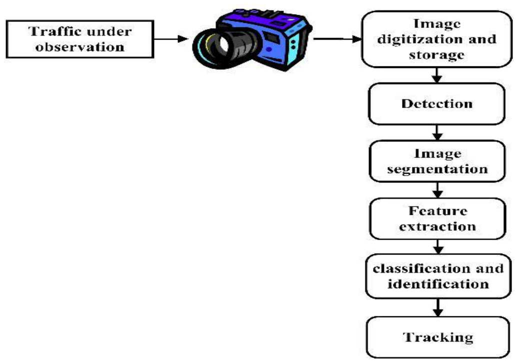

Fig 1.General Flow Diagram of Video Tracking

In this paper, an effective target tracking system in videos using various preprocessing, feature extraction and classification techniques are proposed.

This rest of this paper is organized as follows, Section II illustrates the various preprocessing algorithms, feature extraction and the classification techniques for an efficient target tracking system. Section III describes the proposed work, and the paper is concluded in section IV.

II. RELATED WORK

Video Tracking or target tracking system is the process of tracing the objects, which are moving over time. The main objective of video tracking is to associate the target objects in consecutive video frames. Table I depicts comparative and survey of video tracking and methods.

TABLE I LITERATURE SURVEY

Author/Year	Paper	Method	Advantages	Disadvantages
L. Wang, T. Liu, G. Wang, K. L. Chan, and Q. Yang	Video tracking using learned hierarchical features	A hierarchical feature learning algorithm for object tracking	The adapted features were robust to both complicated motion transformations and appearance changes of specific target object.	The performance of the system must be improved
L. Lin, Y. Lu, Y. Pan, and X. Chen	Integrating graph partitioning and matching for trajectory analysis in video surveillance	Markov Chain Monte Carlo algorithm	Recover the trajectories against occlusion, interruption and background cluster	For the improvement in computational efficiency the parallel implement for MCMC based interference to be designed
A. Makris and C. Prieur	Bayesian multiple-hypothesis tracking of merging and splitting targets	Bayesian MTT model and a two-step MHT algorithm	Tracking accuracy and computation efficiency was improved	The model was extended to raw sensor data to avoid the artifacts caused by the threshold and the ellipse fitting procedure.
T. Bai and Y. Li	Robust visual tracking using flexible structured sparse representation	Block Orthogonal Matchi ng Pursuit (BOMP) algorithm,	The accuracy obtained from the system was more based on the qualitative and quantitative results	Presence of similar object or the occulusion in the scene
C. Park, T. J. Woehl, J. E. Evans, and N. D. Browning	Minimum Cost Multi-Way Data Association for Optimizing Multitarget Tracking of Interacting Objects	Polynomial time solution approach	It provided the integral solution and minimized duality gap.	Corruption occurred in the driven base.
X. Li, A. Dick, C. Shen, A. Van Den Hengel, and H. Wang	Incremental learning of 3D-DCT compact representations for robust visual tracking	3-dimensional Discrete Cosine Transform (DCT)	It generated the compact energy spectrum for the similar appearance.	Presence of similar object or the occulusion in the scene introduced the failures in the discrimination of target and background
K. Zhang, L. Zhang, and M.-H. Yang	Real-time object tracking via online discriminative feature selection	Multiple Instance Learning (MIL)	computation efficiency was improved	The existence of complicated factors made the accumulated error leads to tracking drift
S. Liwicki, S. Zafeiriou, G. Tzimiropoulos, and M. Pantic	Efficient online subspace learning with an indefinite kernel for visual tracking and recognition	Extension of Kernal PCA from Hilbert to Krien space	The formulation of KPCA in krien space is independent of pre-images.	The high dimensionality in KPCA affected the tracking performance
Y. Li, W. Jia, C. Shen, and A. van den Hengel	Characterness: an indicator of text in the wild	Markov Random Field (MRF) model	accuracy and efficiency was improved	The variation in illusion and contrast are the major problem in text detection and tracking
D. Wang, H. Lu, and M.-H. Yang	Online object tracking with sparse prototypes	Combination of PCA and sparse representation	Used for the online tracking of objects.	The problems in Visual tracking are less robustness and accuracy

III. NEAREST SEQUENTIAL BOUNDARY PATTERN

There are several techniques reviewed in the previous Section and the drawbacks of many techniques are also listed in the related work section. In order to extract the back ground and to retrieve the patterns from a video, a back ground extraction technique such as the Nearest Sequential Prediction (NSP) method and Frame Boundary Pattern (FBP) are proposed. This section illustrates the flow of the proposed work, which is depicted in Fig. 2. The overall flow of the proposed model for the extraction of the patterns from the video frame and the removal of shadows are described in detail. It consists of the following stages such as:

- Preprocessing
- Pattern Extraction
- Classification
- Tracking of Target

A. Preprocessing:

Preprocessing is the initial step of video processing in which the noise or the shadow regions are removed using filtering mechanisms. In this Phase the given input frames are filtered using the Enhanced AMF (Adaptive Median Filter) for smoothening effect.

B. Nearest Sequential Prediction

In this technique, center value of the pixel in each frame is taken. Averaging center pixels noisy pixels are identified. In this model relevancy between the intensity of the neighborhood pixels is referred. It is predicted from difference of previous and present intensity pixels. Finally it forms the chain link of pixels information from the shadow of the background and the foreground detected. The shadow of the image is suppressed by applying the histogram equalization.

C. Frame Boundary Pattern

In this phase attribute vectors are extracted. Frame is converted into a grid arrangement and from the grid formation, the difference in pixels are calculated in several projection of the angle.

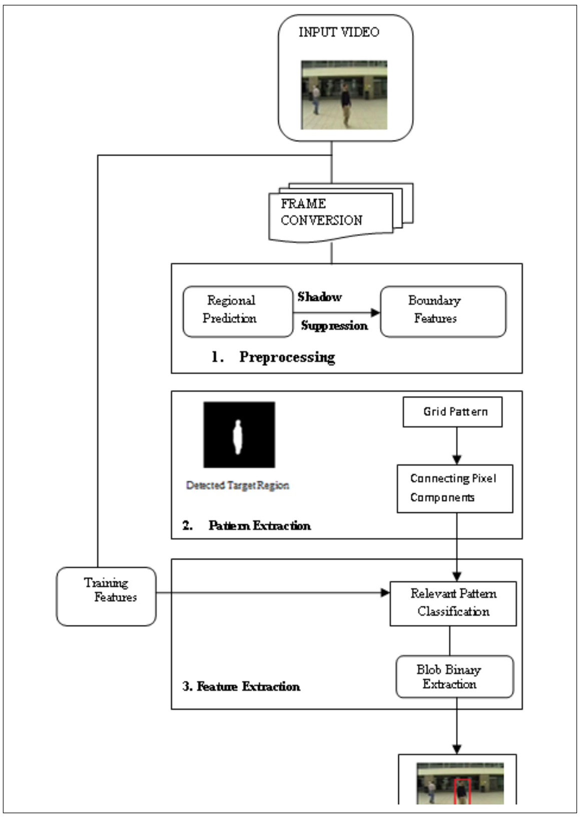

Fig 2 Overall Flow of the Proposed Video Tracking

The histogram attribute vectors are estimated for representing the target frame, which gives the information regarding the moving object. The feature values are used accordingly for extracting the target object from a frame.

D. Relevant Pattern Classification

Relevant Pattern Classification (RPC) algorithm is proposed for tracking the target object from the given video. The extracted features or the patterns are fused and classified using the RPC algorithm. The classification provides the label for the frames using the 0 or 1. The target region, which is detected from the video is marked as 1 and the other regions in the frame is marked as 0, which forms the targeted region effectively classified using the RPC classification. A novel technique is proposed for tracking the target. The target region is applied with the bounding box for representing the tracked target region. The moving objects in the video frame, which is classified using the RPC algorithm are considered as the blobs. The blobs are the region of targeted object in the frames. Then the bounding box is applied for each and every blob in the video frame.

IV. ALGORITHM

A. STEPS

1. Input video frame
2. Preprocessing for Filtering process.
3. Extract chain link formation
4. Detach shadow affected region.
5. Enhance the pixel intensity on the shadow region.
6. Normalize the image in each frame .
7. Formation of Grid arrangement
8. FB Pattern extraction for feature selection.
9. RPC for background prediction and target region using Track the object.

V. EXPERIMENTS AND RESULTS

The proposed method is implemented with windows 8 operating system with Core-i3 and 2 GB

A. Dataset

In this research, there are two videos that are used to evaluate the proposed method. we have taken football video and traffic from CAVIAR dataset.

Fig 3 Input video

B. Experimental Results

The utilization of sequences is 24 frames /secs with the size of 384X288. The average length of the video sequence is about 100s and the entire datasize is 210MB in MPEG4-format.

Fig 4 Preprocessed Frame

Fig 5 Pattern Selection

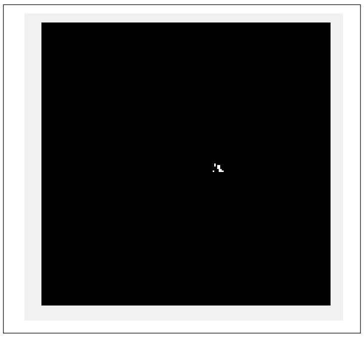

Fig 6 Background Substraction

Fig 7 Target tracking

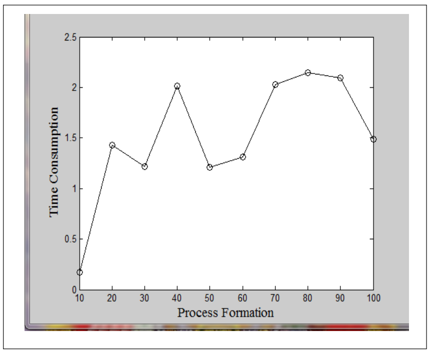

Fig 7 Time consumption

C. Analysis Parameters

The overall performance of methodologies are assessed by means of measuring the True Positive (TP), True Negative (TN), False Positive (FP) and False Negative (FN) computations obtained on comparing the images being processed and those original images acquired from a video sequence.The proposed work is compared with several parameters such as:

TP (true positive):

detected regions that correspond to moving objects,

FP (false positive):

detected regions that do not correspond to a moving object,

FN (false negative):

moving objects not detected.

a) ***Specificity***

It is the measure of the negatives, which are identified correctly. This parameter is used for analyzing the propose work.It is expressed using the following equation

$$Specificity = \frac{number\ of\ true\ negatives}{number\ of\ true\ negatives + number\ of\ false\ positives}$$

b) ***Sensitivity***

It is the measure of the positives, which are identified correctly. This parameter is used for analyzing the propose work.It is expressed using the following equation (2).

$$Sensitivity = \frac{number\ of\ true\ positives}{number\ of\ true\ positives + number\ of\ false\ positives}$$

c) ***Accuracy***

It is the other metric used for analyzing, which is defined as the measure or the test method. It measures, what it is supposed to measure. It is represented as below:

$$Accuracy = \frac{tp + tn}{tp + tn + fp + fn} \quad (3)$$

*d) **Precision***

Precision metric is defined as the value assessed between ratios of the associations between any two patterns retrieved at a single instance of time.

$$Precision = \frac{TP}{TP + FP}$$

NSBP model provides the precision value of 96.98%. The proposed method has a precision value of 33.7% improvement compared to HMRF (64.2%)

e) Recall

The proportional value inferred from those associated patterns and those retrieved patterns .

$$Recall = \frac{TP}{TP + FN}$$

NSBP provides the recall value of 96.7 .The proposed method offers 32.99% improvement compared to HMRF (64.8%)

f) F-Measure(F)

The association inferred between precision and recall is defined as F1-measure.

$$F = 2.\frac{Precision.Recall}{Precision + Recall}$$

g) Complexity Analysis

The proposed method has the complexity depends on the patterns (P), and the Boundary grid cells (B) like O(P+B) which is less compared to the existing models Table I illustrates the comparative analysis between precision, recall and F1 measure observed on realizing GVO and NSBP on the standard dataset.

TABLE II COMPARATIVE ANALYSIS

Tracking methods	Precision	Recall	F1 measure
ZHU	0.549	0.953	0.688
NSBP	0.9793	0.9758	6.19%

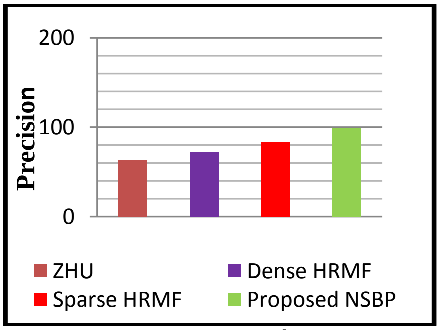

Fig 8 Precision value

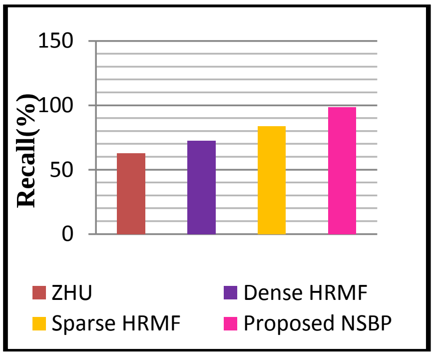

Fig 9 Recall value

TABLE III SUCCESS AND FAIRE RATE

Tracking methods	Success rate	Failure rate
CT	**85.92**	**10.7**
Struck	**87.32**	**11.7**
PartT	**54.93**	**23.3**
MVS	**90.14**	**6**
NSBP	**97.95**	**3.86**

VI. CONCLUSION

In this paper, several techniques such as preprocessing, pattern extraction, classification techniques are analyzed and surveyed. Its disadvantages of the various techniques in each paper are studied. The employment of texture pattern analysis in proposed work improved the robustness over the sudden illumination changes and the dynamic background. The comparison of proposed Nearest sequential boundary pattern with the existing segmentation techniques regarding the accuracy, precision, recall, F-measure, success and error rate assured the effectiveness in visual tracking applications. The integration of correlation-based filters with the adaptive shape variations to be considered as the future work for further improvement in tracking performance.

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