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Robust Video Tracking System with Shadow Suppression Based on Feature Extraction

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ABSTRACT

*Background:*Video tracking is a modernized technology of video processing that retrieves the target object from each video frame. During the target tracking process, multiple factors introduce significantly large errors. *Objectives:* This paper surveys the multiple techniques used for pre-processing, pattern extraction, classification and target tracking. The traditional pre-processing techniques such as mean filter, median filter and adaptive median filter are analyzed. The analysis results prove that these filters do not provide satisfactory results in removing the shadow from video frames. Pattern extraction is the process of choosing only the suitable patterns from the pre-processed images. The existing techniques used for the pattern extraction are Local Binary Pattern (LBP), Local Ternary Pattern (LTP) and Local Tetra Patterns (LTrP). The analysis of these techniques show that the selection of the pattern do not convert frames efficiently. The existing techniques used for the classification of the video frames are Support Vector Machine (SVM), Relevance Vector Machine (RVM) and Fuzzy Relevance Vector Machine (FRVM). The analysis of these techniques prove that these techniques have minimal classification accuracy and less effectiveness. Further, the analysis of multiple target tracking techniques show that they consume more training features and inability to validate the matching points. *Results:* To address the issues in the existing pre-processing techniques, a Neighborhood Chain Prediction (NCP) is proposed. The pattern from the target region are extracted using the Differential Boundary Patterns (DBP). From the extracted target region, the Machine Learning Classification (MLC) algorithm classifies the target regions. The target tracking performance of the suggested method is validated using the parameters such as sensitivity, specificity, accuracy, positive likelihood and negative likelihood. *Conclusion:*The performance results prove that the proposed method provides optimal results for all the metrics than the existing techniques.

INTRODUCTION

In recent years, most of the research are based on the visual tracking system. Video tracking is the analysis of the target objects that has variable backgrounds and non-stationary images. Object tracking is the process of detecting the location of the objects in a video file. Some of the popular applications of the visual tracking system are as follows (Garima Singh, 2015),

- Surveillance tracking
- Robotics
- Medical imaging
- Vision based control

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- Human-to-machine interfaces

Due to the issues related to the mobile platform, gimbals-based stabilization errors and Geo-registration errors the target tracking in aerial images is complex than the traditional tracking. Further, the presence of noises, shadows, complex object motion, complex object shape, illumination changes and partial occlusions make the object tracking process difficult in the moving object detection system. This results in the misclassification of target tracking and false detection of moving objects. The overall steps involved in the general video tracking system is represented in Fig.1. From the figure it is clear that the video traffic is captured using the camera (Hu, Chen, Chen, Huang, & Wu, 2015). 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.

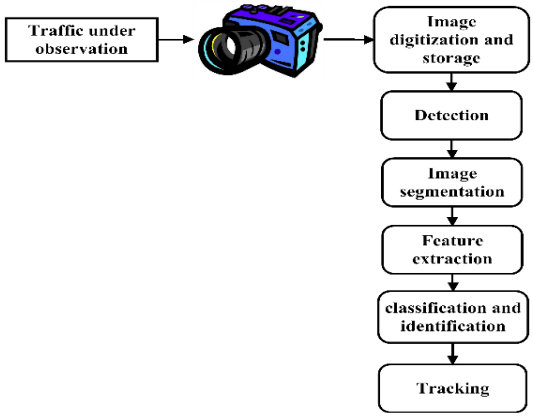

Fig. 1: Overall flow of the general video tracking system

A. Motivation:

Pre-processing is defined as the process of removing the noise and shadow portions in the video frames. Some of the existing pre-processing techniques are mean filter, median filter and adaptive median filter. Though these techniques filtered the noise they do not eliminate the shadows in the video frames. Thus, to address this problem, a novel model of background clustering based on Neighborhood Chain Prediction is proposed. The suggested algorithm suppressed the shadow portions by dividing the frames into grids. Pattern extraction is the process of choosing the target region from the pre-processed image. The existing techniques that are generally used for the pattern extraction are LTP, LTrP and LBP. But, these techniques do not provide an optimal frame and pattern conversion. Hence, a DBP is proposed for extracting the target regions. By exploiting the target regions, the classification algorithms such as SVM, RVM and FRVM classify the patterns into foreground and background. But, the classification accuracy of these algorithms are not satisfactory. Thus, an efficient MLC algorithm is suggested for the classifying the video frames.

B. Objectives:

The key objectives of this paper are as follows,

- To survey the existing techniques and approaches used for pre-processing, pattern extraction, classification and target tracking.
- To implement the NCP algorithm for suppressing the shadows in the video frames.
- To extract the target regions using DBP
- To classify the video frames into foreground and background using MLC algorithm.

The following sections describe the related works, contributions of the proposed work and the conclusion.

Related Works:

Video Tracking or target tracking system is the process of tracing the objects, which are moving over time. The video tracking has several varieties of uses, which are human-computer interaction, security and the surveillance. The main objective of video tracking is to associate the target objects in consecutive video frames. The example of video tracking system is the Video games. The target tracking system has several applications namely,

- Robotics
- Surveillance tracking
- Human-to-machine Interface

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- Security

(Sui, Zhang, & Zhang, 2015) proposed a robust tracking system based on the learning method. In this method, a basic vector matrix is used for extracting the full targeted region. Several numbers of frames are used for predicting the hidden object in the videos. Then the tracking on that area is performed. The main objective of this work is the merging of various number of frames in video predicts the hidden object from the video and it increased the precision rate, when compared to the existing systems .The drawback of this work is it consumes more time for reconstructing the frame and also if the video moves suddenly, then it results in misclassification

(Zhang, Hu, Xie, Bao, & Maybank, 2015)proposed a robust and general tracking system for Low Frame Rate (LFR) videos. The tracking of LFR videos is considered to be an important problem in tracking the target. In this work, the tracking of system consists of four major parts such as Dominant color-spatial based object representation, Bin-ratio based similarity measure, Annealed particle swarm optimization (PSO) based searching and Integral image based parameter calculation. The first two parts are combined for providing the good solution to the appearance and the motion of the target are effectively captured by the annealed PSO based searching. The main objective of this work is the outliers is effectively filtered out .The number of dominant colors is not strongly affected by the size of the object and the main drawback is classification of scene in a video frame was difficult.

(Liu, Wu, & Lin, 2015)proposed a novel hierarchical back-ground model for the intelligent video surveillance with pan-tilt-zoom (PTZ) camera and gave rise to the integrated system consisting of three key components such as (1) background modeling, (2) observed frame registration, and (3) object tracking. The hierarchical model is presented using the image registration concept. Then the background subtraction is used for detecting the foreground objects. The main work of this paper in the image registration process, the targeted regions are identified by referring the multiple frames and this methods separates the background and the foreground effectively and the limitations of the work are several number of frames in the target tracking system and the time for detecting the target consumes more time and are not efficient for frames with shadowing effects.

(Bai, Li, & Zhou, 2015)proposed a novel appearance using the sparse representation and the online learning techniques for visual tracking is presented. The sparse representation is used for the visual appearance. The target is saved as the Dictionary features for getting the training for classification process. Then, the coefficient of the sparse matrix is used for verifying the target region present in the frame. The advantage of using the proposed method is that it is robust for various expression changes and it reduces the feature dataset, which increases the speed of tracking. The main drawbacks of this work are if there is any shadow in the video, then it is considered as the moving object.

Proposed Work:

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 Neighborhood Chain Prediction (NCP) and Differential Boundary Pattern (DBP) 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
- Analysis Parameters

A. Preprocessing:

There are several techniques used for preprocessing the video frames such as: (1) Mean filters, (2) median filters, (3) adaptive median filters etc. But all the filters used are not efficient in removing the shadow regions effectively. Thus in order to remove the shadow regions effectively a novel Neighborhood Chain Prediction (NCP) is proposed. Preprocessing is the first step in every video or image processing in which the noise or the shadow region is removed using some filtering mechanisms. In this module the input frames are filtered using the adaptive median filter for providing the smoothening effect. In the filtering technique, the image is verified using the Gaussian distribution and the median value of the pixel for given window .The noisy pixels are identified and the values of the average pixels are identified. The Neighborhood Chain Prediction (NCP) model referred the relevancy between the intensity of the neighborhood pixels. The difference between the intensity level with connection of previous state of the pixel and the present state of the pixel, which forms the chain link information from the clustered data if image pixels. The shadow of the background and the foreground using the cluster information. The shadow of the image is suppressed by applying the histogram equalization.

B. Pattern extraction:

There are several traditional pattern extraction techniques such as: (1) Local Binary Pattern (LBP), (2) Local ternary Pattern (LTP), (3) Local Tetra Patterns (LTrP) but all these techniques used for selecting the patterns does not efficiently extract the patterns and it did not convert the frames efficiently. Hence, the Differential Boundary Pattern (DBP) is proposed, which overcomes the drawbacks of the existing technologies.

The feature vectors are extracted for all the frames using the Differential Boundary Pattern (DBP) pattern extraction. In this module the frame is converted into a grid arrangement and from the grid formation, the difference in pixels are calculated in several projection of the angle. The histogram feature 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.

C. Classification:

There are several techniques used in the literature for classifying the video frames such as (1) Support Vector Machine (SVM), Relevance Vector Machine (RVM) and Fuzzy Relevance Vector Machine (FRVM). All the methods used for classification has less number of accuracy level and it does not classify the target region effectively. By overcoming the drawbacks of the existing methods a new Machine Learning Classification (MLC) algorithm is proposed in this work for tracking the object from the videos. The extracted features or the pattern fusing the DBP pattern from each frame is classified using the Machine Learning classification (MLC) classification algorithm. It works by extracting the target region by finding the matching point, which is between the target image feature and the feature of the grid. The classification provides the label for the frames using the binary form such as 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 MMLC classification

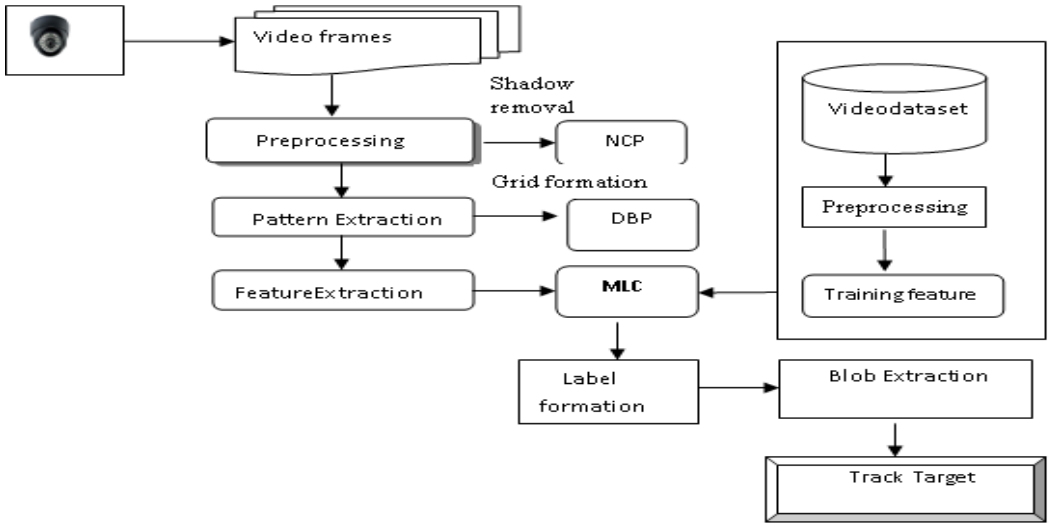

Fig. 2: Overall Flow of the Proposed Video Tracking system

D. Tracking of Target:

The target is tracked by several mechanisms but it has some drawbacks such as it is performed by merging different frames, which consumed bulk amount of training features and if any sudden the intensity changes suddenly then it cannot verify the matching points. In order to overcome the limitations of the existing methods 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 MLC classification algorithms, 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.

E. Analysis Parameters:

The proposed work is compared with several parameters such as:

- Specificity
- Sensitivity
- Accuracy
- Positive Likelihood
- Negative Likelihood

Specificity

It is the parameter that measures the proportion of negatives, which are identified correctly. It is explained using the formula (1).

$$Specificity = \frac{number\ of\ true\ negatives\ (tn)}{number\ of\ true\ negatives + number\ of\ false\ positives\ (fp)} \quad (1)$$

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).

$$Sensitivity = \frac{number\ of\ true\ positives(tp)}{number\ of\ true\ positives + number\ of\ false\ positives} \quad (2)$$

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:

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

Positive Likelihood

It is the ratio of probability that an individual with a disease has a positive test to the probability that an individual without the disease has a positive test. It is calculated using the equation (4).

$$LR+= \frac{Sensitivity}{1-Specificity} \quad (4)$$

Negative Likelihood

It is defined as the ratio of probability that an individual with disease has a negative test to probability that an individual without disease have a negative test. It is explained in equation (5)

$$LR-= \frac{1-sensitivity}{specificity} \quad (5)$$

Conclusion:

In this paper a new novel techniques has been proposed to overcome the existing techniques such as pre-processing, pattern extraction, classification and target tracking. Generally, the pre-processing of the video frames is performed using mean filter, median filter and adaptive median filter. But, these techniques are not optimal in eliminating the shadows present in the video frames. After pre-processing the video frames, the patterns are extracted using existing algorithms such as LBP, LTP and LTrP. These techniques do not provide efficient frame and pattern conversion. From the extracted patterns, the classification algorithms such as SVM, RVM and FRVM are used for classifying the video frames. But, these algorithms do not provide a satisfactory classification performance. Hence, to address these issues, a novel model of background clustering based on Neighborhood Chain Prediction (NCP) algorithm is proposed for suppressing the shadow pixels in the video frames. Initially, the suggested algorithm estimates the lowest intensity portions in the frames then divides the frames into multiple grids. By exploiting the histogram features of the targeted frame, the MLC method classifies the frames into foreground and background. To validate the target tracking performance of the proposed algorithm the parameters such as True Positive (TP), True Negative (TN), False Positive (FP), False Negative (FN), Sensitivity, Specificity, Accuracy, Correction rate, Positive likelihood and Negative likelihood are estimated. When compared to the traditional surveyed methods, the proposed algorithm provides optimal performance for all the metrics. Further, they are robust against the sudden modifications in the illumination and dynamic background.

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