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Moving Object Detection in Compressed Domain of HEVC for Video Surveillance

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Abstract- Detection of the moving objects has many important applications, such as identify abnormal events in the traffic like traffic accidents, monitor activity in public areas, businesses or commercial buildings for real-time or later review. In this work an approach to detect the moving object in compressed domain HEVC is discussed which is used in video surveillance system. Because High Efficiency Video Coding (HEVC) has a large potential to identify events by reusing coding structures in HEVC, which saves vast extent of computational resources. Here the feature Motion Intensity Count (MIC) makes use of motion vector, coding unit and prediction unit of HEVC. By calculating MIC we can predict imprecise the moving objects, then by applying Adaptive Otsu thresholding only on the Largest coding unit (LCU) whose difference in MIC value is greater than zero to get actual segmented output.

Index Terms- Segmentation, video surveillance, HEVC, Motion Intensity Count.

1. INTRODUCTION

Video is used in several different applications like Video Conferences, Medical diagnostic, Security devices etc. Video compression is needed to facilitate both storage and transmission in real time. Digital video shares all the features of other digital formats, including lossless transmission, lossless storage, and ease of editing. A video sequence will be seen as a composition of video objects instead of a set of consecutive frames. Video object segmentation, which extracts the shape information of moving object form the video sequence. Video object segmentation can be described as a method of extracting moving object from each frame of the video sequence. . For object-based representations, it is required to compress each video object as it moves in time. One favourable aspect of compressed videos is that it already contains extra additional information such as partition modes and motion vectors can be viewed as coarse analysis of object. Moreover, comparing to previous video coding standard H.264, the latest standard High Efficiency Video Coding (HEVC), which came out in early 2013, currently there is no published work on event detection in the compressed domain of HEVC. For H.264, there are few related works, which involves object segmentation, tracking, and motion detection. As HEVC have different coding structures with H.264, these methods cannot be directly applied to HEVC.

2. LITERATURE SURVEY

This chapter serves to highlight some of the motivations underlying the object based video coding approach.

Manu Tom, R. Venkatesh Babu [4], they proposed an approach for moving object detection in H.264/AVC compressed domain. The proposed algorithm initially Segemnts based on th quantization parameter and maceo block size, their proposed approach allows the video streams to be encoded with different quantization parameters across macroblocks thereby increasing flexibility in bit rate adjustment. C. Poppe [5], they proposed a fast method for motion segmentation for H.264 based on the size and transform coefficients used within the video stream.This algorithm needs the values of QP to be fixed while encoding, reducing bit rate flexibility.Kalyan Goswami [6],They proposed a new mesh-based moving object detection technique for tracking. A dense mesh has been generated on that part of an frame where the moving object are present else less dense mesh has been formed. This algorithm does not require any prior information about the location of the object inside a video frame. This algorithm capturs moving object inside a video sequence without any pre- or post-processing. the motion characteristics are tuned manually. Dingming Liu [2],Here they introduced a new approach to extract the object based on moving detection and graph cut. Firstly, they get the moving information of the object in each frame with frame difference of three continuous frames. Here the possibility foreground which will segment to extract, It can be solved by graph cut, extract the object in each frame with the graph cut algorithm to segment each frame to extract the moving object. This system still has some limitations. First, when the foreground and background colors are very similar, high quality segmentation usually is hard to be obtained.Vijay

Jumb [3], an approach for color image segmentation is presented. In this method foreground objects are distinguished clearly from the background. Initially RGB is converted into HSV and extract V from HSV, then apply Otsu on V channel and then apply K-means algorithm for over segmented. Huang LI, Yihao ZHANG [1], they proposed an event detection method for surveillance video in compressed domain of HEVC. They proposed a Motion intensity count and motion intensity prediction methods to find difference of frames and abnormal event detection method to find the abnormal events which are typically traffic accidents for traffic video surveillances.

3. PROPOSED SYSTEM

To analyze the captured images to find moving objects, a decoding step is needed. By avoiding this decoding step and we reused the work done during the encoding to detect moving objects directly upon the compressed video stream. The key idea in our proposed system is we are presenting segmentation to extract the moving objects in HEVC compressed domain

The general flow of the system is illustrated in following proposed diagram:

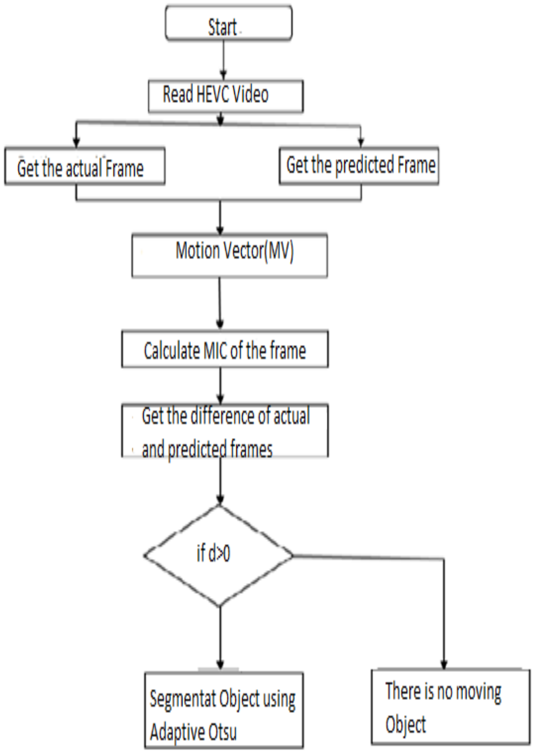

Fig 3.1: Flow of proposed system.

There are mainly two contributions here: the first is a compressed-domain video feature MIC to measure the motion intensity within a video region and a motion intensity transmission method to predict MICs for subsequent frames; the second is that, by identifying the difference between predicted and actual motion intensity. Segment the Video Objects if the difference is greater than zero. Apply Adaptive Otsu thresholding on LCU, if the difference d is greater than '0'.

3.1 Motion Intensity Count (MIC)

We firstly briefly explain the related compressed-domain information in HEVC.

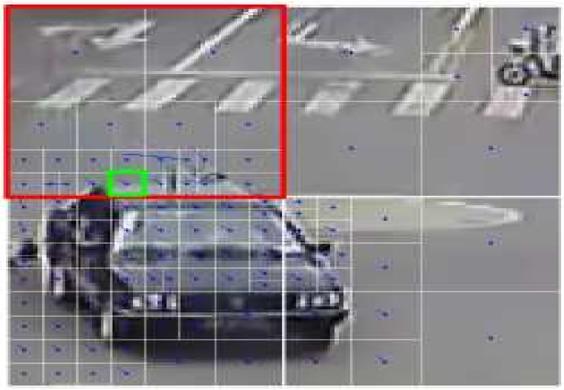

Fig. 3.1: LCU, PU and MV in HEVC.

In HEVC, each frame is firstly divided into squares of equal size, i.e. largest coding units (LCUs). Each LCU can be recursively divided into smaller unit until a proper partition reached. Each smallest unit is referred to as prediction unit (PU). For each inter-coded PU, there will be a motion vector (MV) indicating the best match position in the reference frame. As shown in Fig. 3.1, the red block is one of the LCUs, the green block is one of the PUs and blue lines indicate MVs. LCU with intense motion have longer MVs and finer partitions.
Thus to represent the motion intensity within a LCU. MIC for each LCU is defined as follows:
Using $||MVi||$ the set of the MVs within the same LCU, *area(PUi)* is the is the area of the PU containing this MV . LCU with larger MVs will have higher MIC.

3.2 Motion Intensity Count Prediction

A motion intensity transmission method to predict motion intensity changes between different frames caused by uniform linear motion.
In general, normal movement of pedestrians and vehicles can roughly be regarded as uniform linear motions and small deformation within several adjacent frames, especially when frame rate is high. Therefore, for normal motions, we may predict MIC changes linearly for subsequent frames. In contrast, abnormal traffic events such as traffic accidents often come along with sudden and huge changes in both direction and speed.
That is to say, object movements involving in traffic accidents are far from uniform linear motion, which is not linear predictable. According to this analysis, a motion intensity transmission model which can

predict changes caused by normal movements, i.e. uniform linear motion. For each PU containing a MV in frame n, we predict its new center position in frame m with following formula:

$P_{pred} = P_{cur} - (m - n) * MV$

Then the predicted MIC for each LCU in frame m can be calculated according to the predicted PU locations and MVs.

3.3 Object Segmentation:

Based on the feature of MIC and the MIC prediction method, we moving objects by identifying the difference between the predicted and actual MICs for each frame.

For each currently checking frame, we predict MICs for current frame by previous frames, which are inside a sliding window of size s. For each LCU in current frame, with the predicted MICs and actual MIC we can measure the differences.

If difference is greater than zero then there is possibility of moving objects are present in the LCU. Apply Otsu Adaptive thresholding method on LCU whose value of *d* is greater than zero to extract the moving objects.

3.4 Otsu Thresholding:

The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. Image segmentation is typically used to locate objects and boundaries in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

Edges are significant local changes of intensity in an image. Edges typically occur on the boundary between two different regions in an image. Edges can be modelled according to their intensity profiles. The quality of edge detection is highly dependent on lighting conditions, density of edges in the scene and noise. While each of these problems can be handled by adjusting certain values in the edge detector and changing the threshold value for what is considered an edge.

Segmentation involves separating an image into regions corresponding to objects. The simplest property that pixels in a region can share is intensity. So, a natural way to segment such regions is through *thresholding.*

The simplest method of image segmentation is called the thresholding method. The key of this method is to select the threshold value. Several popular methods are used in industry including the maximum entropy method, Otsu, and k-means clustering.

Thresholding is used to extract an object from its background by assigning an intensity value T(threshold) for each pixel such that each pixel is either classified as an object point or a background point.

Global Thresholding: A single threshold for all the image pixels is used. When the pixel values of the components and that of background are fairly consistent in their respective values over the entire image, global thresholding could be used.

Local or adaptive thresholding: Different threshold values for different local areas are used, the threshold itself to smoothly vary across the image.

The OTSU method is one of the applied methods of image segmentation in selecting threshold automatically for its simple calculation and good adaptation.

Otsu Thresholding: This type of thresholding is global thresholding. It stores the intensities of the pixels in an array. The threshold is calculated by using total mean and variance. Based on this threshold value each pixel is set to either 0 or 1 i.e., background or foreground respectively.

Otsu's thresholding method involves iterating through all the possible threshold values and calculating a measure of spread for the pixel levels each side of the threshold, i.e. the pixels that either falls in foreground or background. The aim is to find the threshold value where the sum of foreground and background spreads is at its minimum. The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the two classes so that their combined spread (intra-class variance) is minimal. The extension of the original method to multi-level thresholding is referred to as the Adaptive Otsu Method.

Adaptive Otsu Thresholding:

The global threshold value is not good in all the conditions where image has different lighting conditions in different areas. In that case, we go for adaptive thresholding.

Here we calculate the threshold for a small region of the image. So we get different thresholds for different regions of the same image and it gives us better results for images with varying illumination.

4. CONCLUSION

The Moving objects identification is based on the information of HEVC compressed domain feature which is Motion Intensity Count (MIC) which is extracted from compressed domain information of HEVC, the Motion vectors, coding unit and prediction unit are used to identify MIC. The concrete segmentation is carried by Adaptive Otsu thresholding to identify the moving object. Here Otsu adaptive thresholding is applied only on the largest coding unit (LCU) whose value of difference in MIC values is greater than zero, but not on entire frame, this is important where image has different lighting conditions in different areas and also it will improve performance simply by applying Adaptive Otsu on specific LCU. This system will useful for video surveillance applications for example like detecting severe traffic incidents online and make it possible to warn traffic operators to take urgent action etc. Compared to other systems, the proposed approach allows the video streams to identify moving object in different approach i.e., by using MIC.

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