

Optimal Criteria Approach for Tracking Motion Detection in Video Surveillance Using Image Processing Techniques

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Abstract: Security system like video surveillance or Close Circuit TeleVision installation in the premises is an essential component for monitoring, recollecting, and observing the events in its actual order for future reference and evidence to the proprietor hypothesis. The process of identifying and tracking motion detection in video surveillance CCTV or any video source system is a tedious process due to its dynamic frame modifications in the image analysis approach. The existing surveillance video motion detection approach methods lacks in the areas of hardware feasibility shortcomings, frame difference detection errors, back ground image analysis failures, unable to perform effective comparison and verification analysis. The main issues of false alarms, ghost, incorrect and irrelevant data plays its substantial role in degrading the performance of motion detection in video surveillance system. This research article proposes a image processing approach for handling motion detection in video surveillance system using image processing techniques. In near future this research article focuses on the implementation of soft computing based motion detection in video surveillance with augmented reality system.

Keywords: Image processing, CCTV, motion tracking, motion detection, video surveillance

I. INTRODUCTION

Image Processing:

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it[1]. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods[2].

Video Surveillance:

Video surveillance involves the act of observing a scene or scenes and looking for specific behaviors that are improper or that may indicate the emergence or existence of improper behavior[3].

CCTV:

Closed-circuit television, also known as video surveillance, is the use of closed-circuit television cameras to transmit a signal to a specific place, on a limited set of monitors[4].

Motion Detection: Motion detection is the process of detecting a change in the position of an object relative to its surroundings or a change in the surroundings relative to an object[5].

II. METHODOLOGY

The proposed methodology contains 5 stages of implementation. They are

Basic requirements:

- ✓ Surveillance video sequence of optimal length is taken into consideration for motion detection using image processing techniques.
- ✓ The image clarity is the essential component for this entire research process[6].
- ✓ The noise reduction and blurred video sequence removal are default approaches in the research process.

Stage-1: Initialization

The image analysis in any image processing techniques starts with the initializing procedures with proper selection of initial frames.

Normally the proper selection of image initialization plays the vital role in the reduction on processing complexity in the image processing based motion tracking approach.

Stage-2: Criteria based motion tracking computation

Motion tracking or identification computation depends on the difference between the current frame and the initialized frame.

The comparison filters the moving objects or persons from the image and set the collection as movable foreground components.

Stage-3: Background renovation

The effectiveness in the comparison process enters into the complex state due to its longevity in iteration process.

The motion detection is not an easier task for identifying the moving objects as it is present in the image.

For longer iterations the old background image must be replaced with the current background image by avoiding the natural environmental factors. This approach is called as background renovation.

Stage-4: Foreground detection

The object tracking methods such as heatmaps and colormaps and contour detection are used for tracking the motion in an image frame of a surveillance video sequence.

Heatmaps identifies the object or persons movements in the scene with proper temporal variation wit an overlay feature on the basic frame.

Colormaps tracks the motion with the proper extraction of changing pixel color variations in the motion detection image component in a video sequence.

Stage-5: Verification

The motion detection verification is done through Gaussian mixture or fuzzy logic approach for the confirmation of pixel modification in the corresponding regions.

The verification process entrusts the motion detection process for further investigation with proper confirmation for the event occurence validity.

The video surveillance system is a sensitive domain which relies on the verification confirmation for motion detection for future references.

The proposed methodology of optimal criteria approach for tracking motion detection in video surveillance using image processing techniques is as follows in Fig-1.

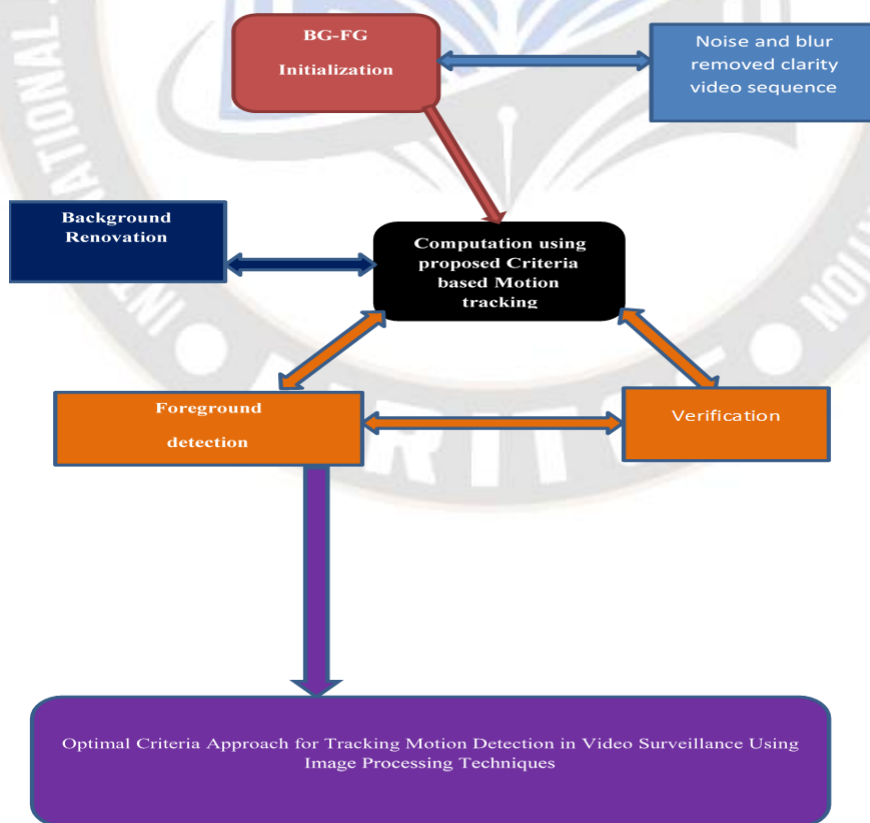


Fig-1: Proposed preference compositional approach for client structured web customer segmentation

The flow chart for optimal criteria approach for tracking motion detection in video surveillance using image processing techniques is as follows,

Start

Input: Video sequence for motion detection

Step-1: Clarity correction.

- a. Removal of noise.
- b. Removal of blurred image component.
- c. Remove unstructured image frames.
- d. Remove full black or full white or full colored complete sequence.
- e. Remove full pixel vibrating frames.

Step-2: Initialization

Set Back ground=Frame-zero

Set Current frame=Frame-1

Step-3: Computation using proposed Criteria based Motion tracking

1. Perform needed Background alteration
2. Compute frame difference.
3. Identify foreground components for motion.
4. Composition of Customer segmentation preference approach.

Step-4: Background Renovation

If Nochange in image frames comparison then Update Background and goto step-3 else

Identify foreground of motion components goto step-5

End if

Step-5: Perform verification

Show the motion detection results.

End

III. IMPLEMENTATION

a. Initialization

Set Back ground=Frame-zero and SetCurrent frame=Frame-1 as in Fig-2.

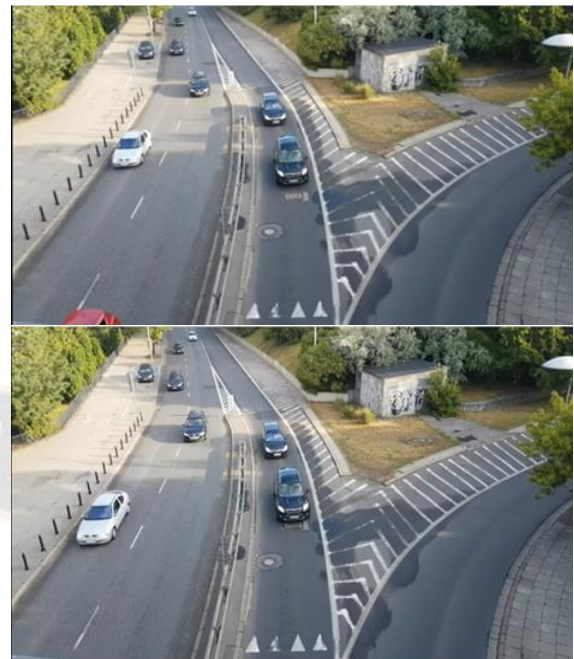


Fig-2: Background and Foreground initialization.

The following removal operations were performed for the image clarity function,

i. Noise removal image

Removing the noise from the image frame is as represented in Fig-3.

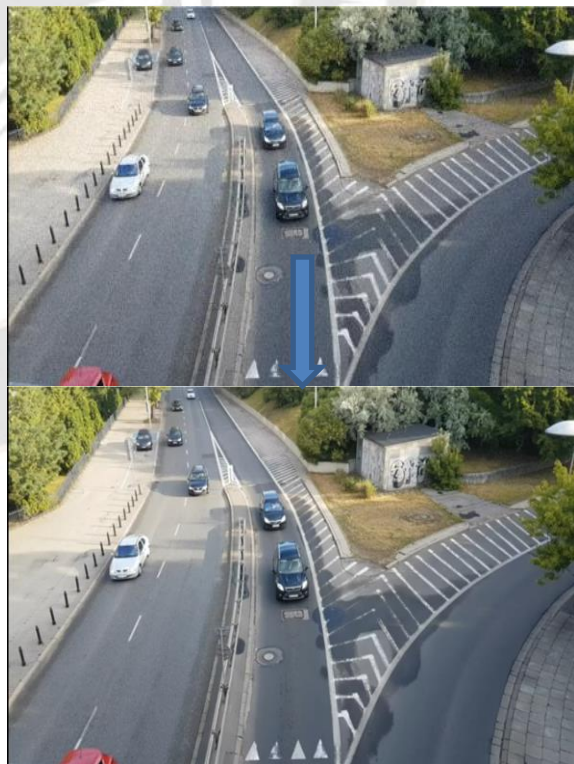


Fig-3: Image Noise removal

ii. Blur removal image

The blurred components removal for the image is represented as in fig-4.

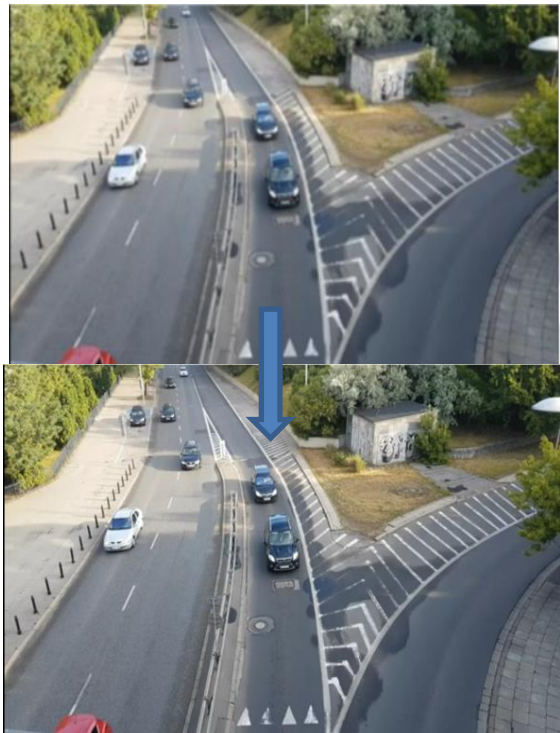


Fig-4: Blurred components removal in image frame

iii.sample unstructured image

Unstructured images as in fig-5 are complex image visuals which are not in any use for motion detection process, such frames must be discarded for effective analysis.

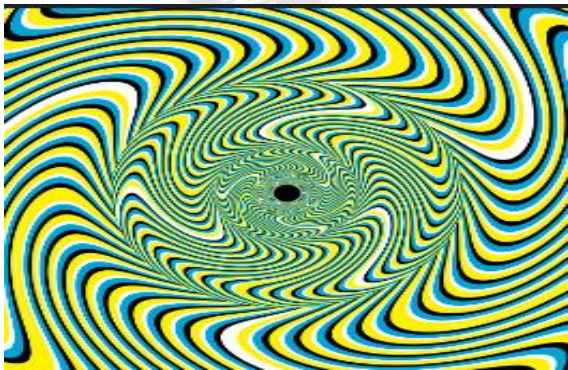


Fig-5: Unstructured image frame sample in technical fault video collection.

iv. Full black or full white image

The full black or full white images as in fig-6 plays null role in foreground motion detection. These image frames are removed from the research data set collection.



Fig-6: Full black or full white/blank frames

v. Remove full pixel vibrating frames

Vibrating frames as in fig-7 are the collection of signal lost indication frames in which the time slots are only noted without taking the frames for comparison.

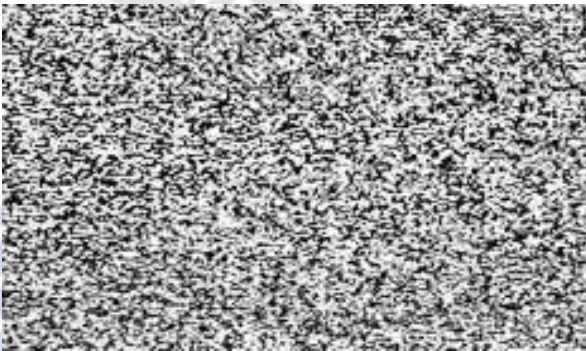


Fig-7: Vibrating signal lost frames

b. Computation using proposed Criteria based Motion tracking

Perform Background alteration through the following modifications from the given set of image frames.

Create a minimum of 1 or a maximum of 12 Pivotal Back ground frames inorder to create a total of at least 2 vibrational threshold pivotal back ground frames for the comparisons.

12

Frame Comparison- $F(\text{Image } I_x) = \text{Current Frame}(CF) - U$
Background(y) -----(eq-1)

$y=1$

The pivotal back ground frame variations are as follows,

- i) The three basic variation based on shadow effects for an image
 - ❖ Light
 - ❖ Medium
 - ❖ Dark
- ii) The three basic variation based on reflection effects for an image
 - ❖ Regular
 - ❖ Diffused

❖ Multiple

iii) The four basic variation based on lighting condition for an image

❖ Ambient

❖ Task

❖ Accent

❖ Decorative

iv) The two basic variation based on environment factors of an image

❖ Natural

❖ Automatic

The computations are based on the above variations which are handled through fast processors for taking the frameset in a predefined manner from the selection of sequence from a surveillance video collection.

Compute foreground-1=current frame-background[x] {x/x=1 to max variation(2 to 12)}

For the current research module the following variations are possible for the effective comparisons.

a. Lighting variations

i. Low light is represented as in fig-8.

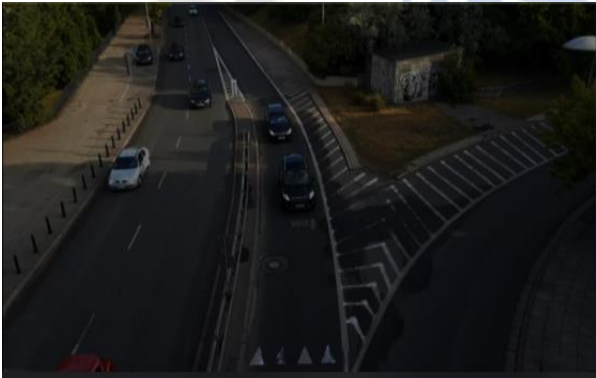


Fig-8: Low light Frame

ii. Medium light is represented as in fig-9.



Fig-9: Medium light Frame

iii. High light is represented as in fig-10.



Fig-10: High lighted frame

b. Shadow variations

i. Shadow variation-1 clarity is represented as in fig-11.



Fig-11: Thick shadow variation

Shadow variations are taken into considerations due to the false alarms initiated by the multiple motion detections. The duplicated shadows are discarded moreover the shadow avoidance in clarity helps the objects movement tracking in an effective way.

ii. Shadow variation-2 clarity is represented as in fig-12



Fig-12: Light shadow variation

c. Background Renovation

For all the 12 variations as in eq-1.

Perform the following operation in a serialized manner;

If foreground=No change or NULL then

Background=current frame

Update background

Continue the process

End if

The implementation is done by changing the background image-1 and backgroundimage-2 with the successive sequences until all frames are compared as in fig-13 and fig-14.

During the initial comparison process

Execute the following operation;

if there exists no change in the scenario then

background image-2=background image-1



Fig-13: Old Back ground image

else backgroundimage-2=current image



Fig-14: New Back ground image

end if

d. Foreground detection

The Foreground detection process includes the following operations for the effective motion detection.

If fore ground<> Null then

Fore ground=foreground-1

Perform object tracking using image processing Heat map/Color map for object movements overlay

End if

i. Color map verification is represented as in fig-15 as follows;



Fig-14: Color map variation

ii.Heat map verification is represented in fig-15 as follows;

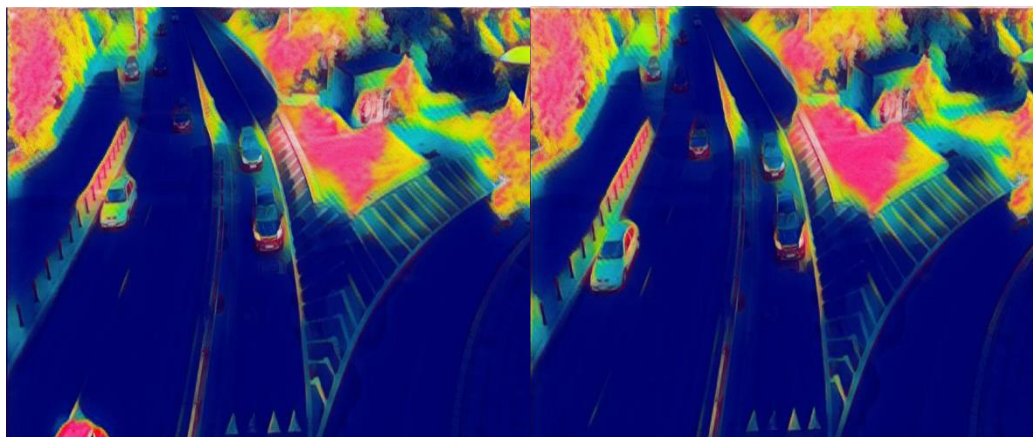


Fig-15: Heat map variation

The foreground detection clearly identified the motion of cars in the given sequence such that except on car that is car position-5, all the cars are in motion state.

e. Verification

Dynamic back ground image verification by Gaussian method which states that highly deviated objects are in moving state are computed as in table-1.

Table-1: Motion variation verification based on gaussian method.

Object	Standard deviation	Weight/SD	Motion detection
Car1	High	Low value	Yes
Car2	High	Low value	Yes
Car3	High	Low value	Yes
Car4	High	Low value	Yes
Car5	Low	High value	No
Car6	High	Low value	Yes
Car7	High	Low value	Yes
Car8	High	Low value	Yes

The collection of 10 video sequences in the selected video material produces 9 out of 10 sequences with correct motion detection tracking in a successful way. The proposed optimal criteria approach for tracking motion detection in video surveillance using image processing techniques produces 90% success rate in the process of motion detection tracking.

IV. RESULTS AND DISCUSSION

Consider the video collections from Kaggle standard data set[7] and Papercode[8] with a collection of 18 videos.

The proposed methodology produces good results without any errors or deviations due to the video processing approaches using image processing techniques.

This research article produces 92.2% (166 out of 180 video sequence sets) of success rate for the optimal criteria approach for tracking motion detection in video surveillance using image processing techniques.

The parametric comparison between existing and proposed methods with precision, accuracy etc. are represented in the below Table-2 format,

Table-2: Proposed methodology parametric comparisons

No	Approach	Accuracy	Precision	Recall	F1 score value
1	Pixel variation based motion detection approach.	69%	0.68	0.71	0.69
2	Optimal criteria approach for tracking motion detection in video surveillance using image processing techniques.	92%	0.91	0.93	0.92

The following fig-16 shows the performance comparison between the proposed and existing methodologies.

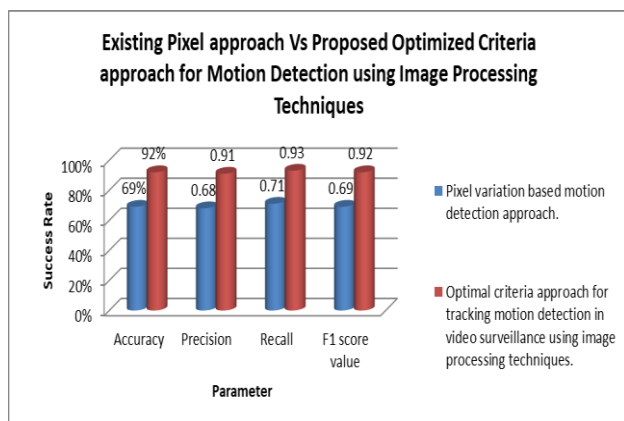


Fig:- Proposed vs. existing methodology performance comparisons

V. CONCLUSION

Motion detection plays the vital role in image object analysis feature in a successful manner. The process of handling large amount of video surveillance collection using the manual image comparison process is very difficult to handle and very hard to analyses towards motion tracking in movement detection.

The existing methodologies for pixel comparison approach directly applying the image comparison approach in which the results are irrelevant in terms of optimized motion detection. Motion detection in surveillance videos requires proper image handling tools to implement the motion tracking procedures in a successful way.

This research article proposes 5 stages of tracking in motion detection process, initially the image clarity correction procedure is performed for better results, the initialization of back ground and foreground images acts as the significant part in th moton tracking of video surveillance system followed by the background renovation towards continual process along with the foreground detection as the key heart step for motion detection,finally the verification stage concludes the motion detection without any false alarms..

This research article produced 92% success for the motion detection in video surveillance system.

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