Detection of Moving Objects in Colour based and Graph's axis Change method

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Abstract
This paper describes two algorithms for detecting moving objects in video surveillance with a VGA camera. Based on the grey-level change characteristic between two successive video frames, grey information is broadly used for the detection of moving objects. However, the method will lose a lot of useful colour information. In this paper First algorithm detects the moving objects in colour domain. This method depends upon intensity of light or brightness of colours and does work only, when the object and background have different colour. On other hand, Second algorithm is implemented for removing the disadvantages of background subtraction method (do not work with varying background), and Colour method (movement of objects is not detected when the background and object have same colour). This new method (Graph's axis change method) does not depend upon intensity of light and background model. Graph's axis change method works with the movement of pixel according to x and y axis. After implementation, First method is compared with Graph's axis change method. Second method takes less time and successfully extracts moving edges from dynamic images sequences.
Keywords- Motion detection, Space vector difference method, Graph's axis change method, Background and foreground model.

1. Introduction

Video surveillance systems are getting more popular every day in monitoring security sensitive areas such as banks, highways, borders, forests etc [2]. In general, video outputs of the more sensitive areas are processed online by human operators and the remaining video outputs are recorded for future use in case of a forensic event. However, as the number of surveillance systems increase, human operators and storage devices are becoming insufficient for operating of these systems. Sensors which detect the moving objects used in almost all video surveillance applications. Several techniques for moving object detection have been proposed. In among them, the three representative approaches are temporal differencing, background Subtraction and optical flow. Temporal differencing based on frame difference, attempts to detect moving regions by making use of the difference of consecutive frames (two or three) in a video sequence [3]. This method is highly adaptive to dynamic environments, but generally does a poor job of extracting the complete shapes of certain types of moving objects. Background subtraction is the most commonly used approach in presence of still cameras. The principle of this method is to use a model of the background and compare the current image with a reference. In this way the foreground objects present in the scene are detected [4]. The method of statistical model based on the background subtraction is flexible and fast, but the background scene [5] and the camera are required to be stationary when this method is applied. Optical flow is an approximation of the local image motion and specifies how much each image pixel moves between adjacent images [6]. It can achieve success of motion detection in the presence of camera motion or background changing. According to the smoothness constraint, the corresponding points in the two successive frames should not move more than a few pixels. For an uncertain environment, this means that the camera motion or background changing should be relatively small. The method based on optical flow is complex, but it can detect the motion accurately even without knowing the background [7]. The main idea in this paper is to implement the colour based and graph's axis change method with a simple VGA camera, detection of moving objects in a video surveillance and comparing these algorithms according to their time domains.

2. Colour Based Method

Based on the grey-level change characteristic between two successive video frames, grey information is broadly used for the detection of moving objects. Reference [5] builds background based on the hypothesis of background pixel with maximum probability. It will lose a lot of useful colour information if use grey image only. For example, there are a red point, value of RGB is (255, 0, 0), and a blue point, value of RGB is (0, 0, 255) on the same position in successive video frames [1]. It is apparent difference between them. However, their grey identity is not different. In this case, a blue moving object cannot detect successfully in the red background. To remove this disadvantage, colour based techniques is implemented. This technique uses the concept of space vector machine. The method utilizes the space vector difference to obtain a difference map between current video frame and back-ground model [1]. Gray scale filter and blob counter are used in this method.

The Principle of Space Vector Difference -

Space vector difference uses three primary colour- Red, Green and Blue. Here we take a frame of pixels and set the value to each pixel of RGB colour in an image which represents the vector (r, g, b) in colour space. Vector length and distance are important attributes of vector [1]. The difference of vector reflects the difference between two pixels at the same positions in two images. Difference is given by D(r, g, b) and calculated as-

Difference(r, g, b) = Image(r, g, b) – Background(r, g, b)

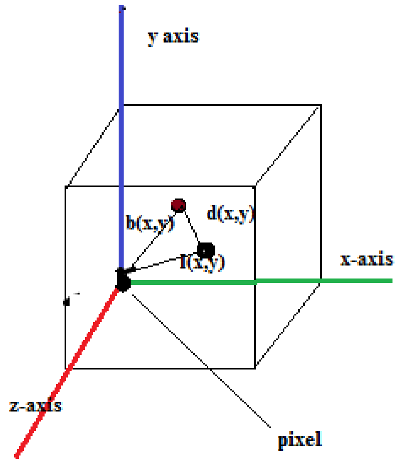


Figure1 Space vector difference of point x, y in RGB colour space.

In this method, each pixel is represented by a colour model that separates brightness from the chromaticity component. A given pixel is classified into four different categories (background, shaded background or shadow, highlighted background and moving foreground object) by calculating the distortion of brightness and chromaticity between the background and the current image pixels [8]. There are so many fluctuations in this method because it depends upon the intensity of light. This algorithm also contains the shaded region as a moving object where the intensity of light is increased. Then the colour vector of each point in the original image is replaced by its nearest reference colour vector in the sense of Euclidian distance.

3. Graph's Axis Change Method:-

This is a method in which pixels of an images are changed according to x axis and y axis. There is no such type of concept like fixed background and changeable background as in colour method. This method detects the moving objects according to changeable position of pixels. If pixel changes its position according to x axis and y axis in a time period then we find the velocity and magnitude of positions. So we can detect the objects .when the object is detected an alarm is generated. This system is used for security purpose. For this we take a normal VGA camera for capturing the images in a video surveillance. In this method less hard disk is used because in a video surveillance camera capture the pictures only when the object is passed rather than regular recording of that area. There are more fluctuation in colour based method rather than second method because it depends upon intensity of light. On the other way Graph's axis change algorithm does not depend upon intensity of light, it only depends upon single pixel's movement.

4. IMPLEMENTATION -

4(a) Implementation of colour based technique

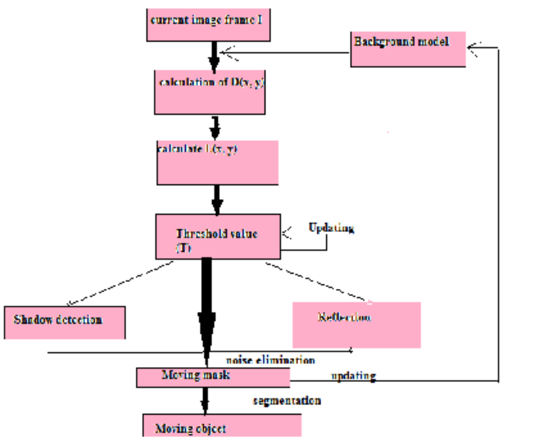


Figure2 shows the implementation process of colour based technique.

When the difference(r, g, b) is calculated through image(r, g, b) – Background(r, g, b) then Vector length is calculated.

$L = |D| = (D^2_r + D^2_g + D^2_b)^{1/2}$

The value of L is compared with Threshold. If the value of Vector length is less than threshold then F(x, y) is 1 and moving objects are detected Otherwise the values of F(x, y) is 0. Firstly we take the value of threshold 10. According to Reference [1] Authors Zhen Qian, Debao Huang and Xiaohui Mao in "Moving Objects Detection Based on Space Vector Difference" the value of threshold is taken as 10 but our environment is totally different. This colour based algorithm depends upon intensity of light. Intensity of light should be different from one region to other region and also depend upon temperature, pressure etc. The value of F(x, y) is calculated at TH1, TH2 and so on. Sometimes false objects are detected due to increase in threshold value. So we adjust the accurate threshold value for detection of moving objects. It gives best result at value 10.

4(b) Implementation of Graph's axis change method.

In video surveillance we take the pictures of scenes using a camera. The original picture is divided in to pixels. Then we check the motion of a pixel according to x axis and y axis with respect to time T. According the values of x and y components we calculate the velocity of object. The velocity of an object is taken as no of objects moving in a distance per unit time in an area. We can call this vector method .In this vector method we find the magnitude of vector according to x axis and y axis.

Velocity=distance/time

$V= (V^2{}_X + V^2)^{1/2}$

Consider a pixel of a moving object at point A (pixel coordinates (x, y) at time t) with image brightness equal to

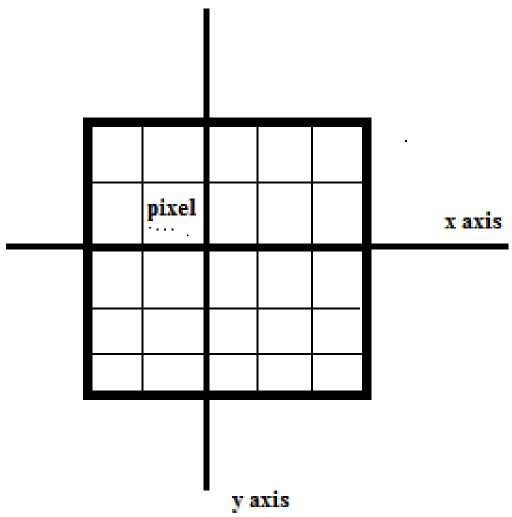


Figure3. Original picture divided into pixels and movement of pixels according to x axis and y axis.

I(x, y, t). Because of object movement between frames, this pixel moves to point B (new pixel coordinates being (x + dx, y + dy) at time t + dt); implying that the pixel coordinates (x, y) change in time dt to (x + dx, y + dy). It is assumed that the image intensity or brightness I(x, y, t) of the pixel with coordinates (x, y) is constant (brightness constancy assumption) in both these frames.

The brightness constancy assumption thus results in the following equation:

$I(x, y, t) = I(x + dx, y + dy, t + dt)$ .... 1.

Using Taylor series expansion (only consider first order terms) the right hand side of the above results.

$I(x + dx, y + dy, t+dt)= I(x,y,z)+ \partial I/\partial x*dx+\partial I/\partial y*dy+\partial I/\partial t*dt+$........... 2.

$\partial I/\partial x*dx + \partial I/\partial y*dy + \partial I/\partial t*dt =0$ 3

Divide this 3rd equation with dt and results are given below

$\partial I/\partial x*dx/dt + \partial I/\partial y*dy/dt + \partial I/\partial t = 0$ 4

The components according to x axis any y axis are denoted as

dx/dt = u.. .5.

dy/dt = v .... .6.

Then the values of u and v are taken in equation 4

$\partial I/\partial x*u + \partial I/\partial y*v = -\partial I/\partial t$ 7

According to lucas kanade method we take is equation as

$\partial I/\partial x=I_x$ 8

$\partial I/\partial y=I_y$ 9

We put these values in equation 7

$I_x*u + I_y*v = -I_t$ 10

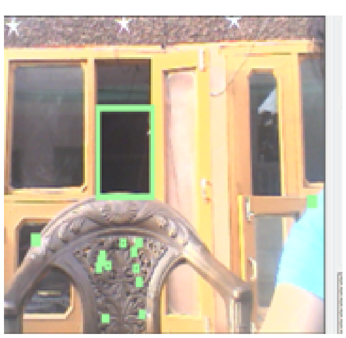
Then we set the Threshold value from 0.95 to 1.05. After this we divide the new value of pixel to old value. The result obtained from it is compared with threshold value. If the output is lies between threshold values then object is detected and alarm is generated.

5. RESULTS AND DISCUSSION

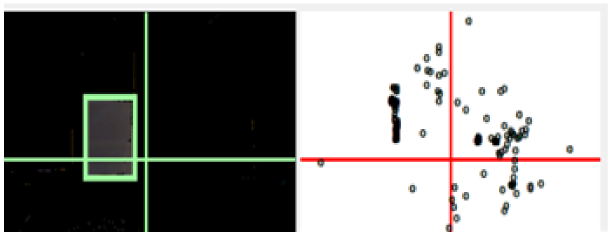
Colour based method results

(a) Input image

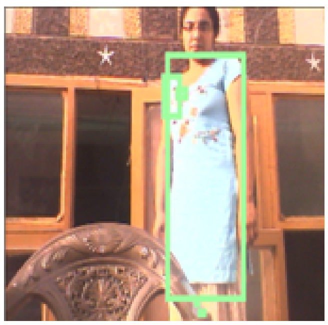
(b) Image when the black color is taken as background.



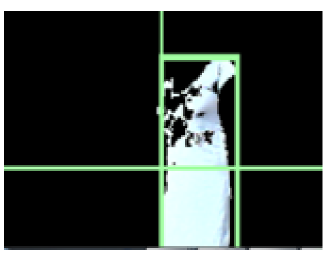
(c) Rectangle shows the proper position of that region and black dots shows colour of the background.



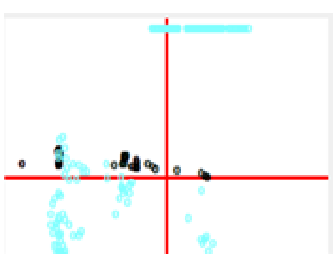
(d) Image when the object is passed and detection of object is shown by rectangle.

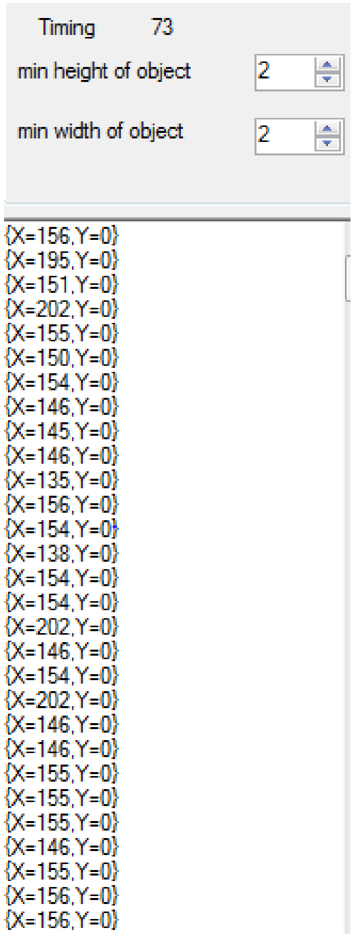


(a) Rectangle shows proper region of color detection.



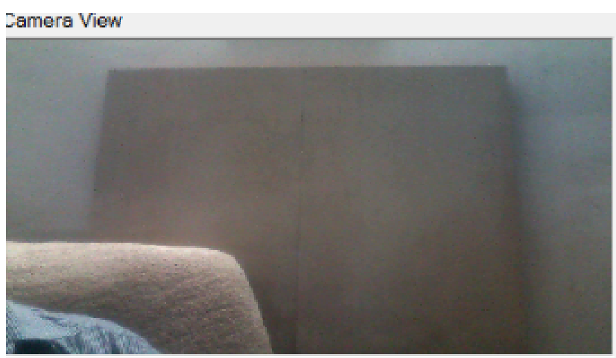
(b) Dots in this picture show the color and time varies between 55 and 73.



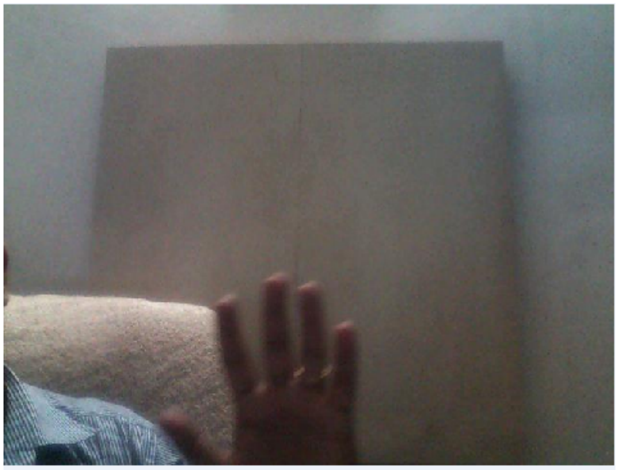


Graph's axis change method results-

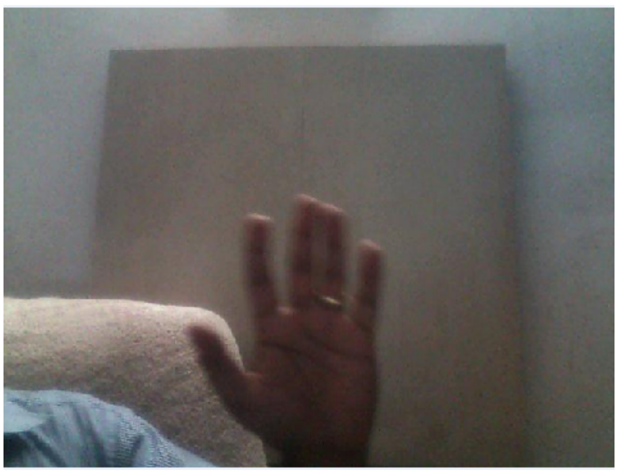
(a) Input image when no movement is there.



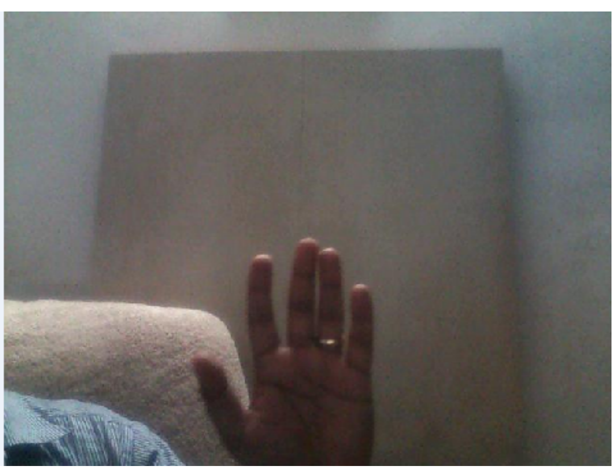
(b) Outputs when the hand moves from one position to another position and security alarm is generated.



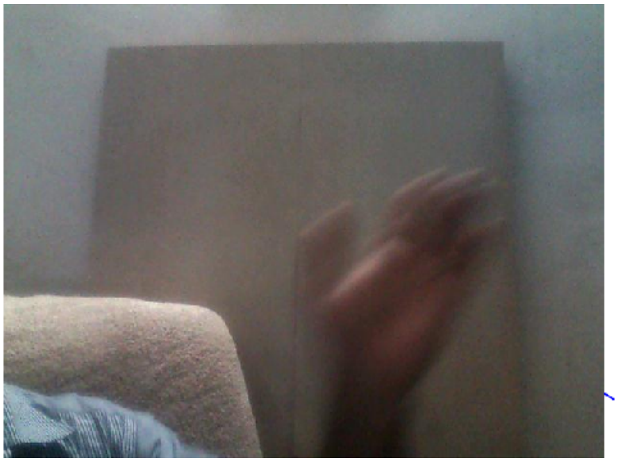
Frame 1



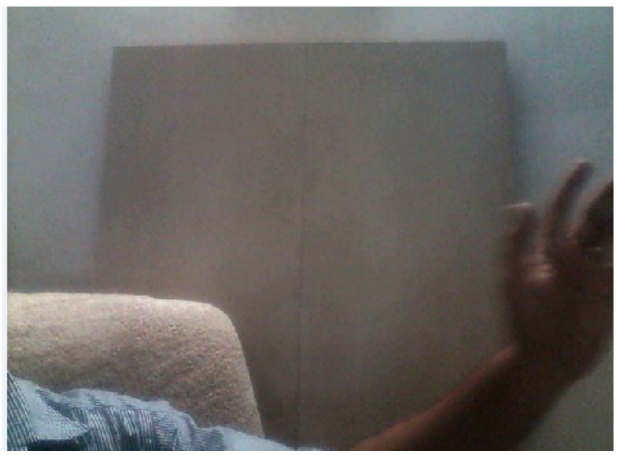
Frame 2



Frame 3



Frame 4



Frame 5

Time is changed according to single pixel movement and graph is generated.

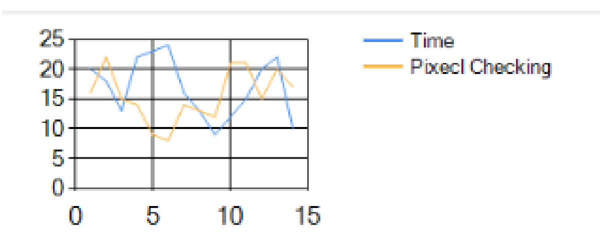


Table shows all values of time according to pixel change.

tim	pix
10	20
50	60
20	20
8	19

Discussion- Colour based algorithm detect the moving objects according to there colour. When the background colour is black and object's colour is different it easily detects the moving object but, it does not easily capture the moving objects where the background colour and object colour is same. Secondly this algorithm depends on intensity of light. If, the brightness increases it detects that region in rectangle shape and take it as a moving object. There are more fluctuations in this method that's by it generate alarm in regular manner when there is no movement. In this algorithm a camera is fixed and regular recording of that particular region is taken. The second method depends on movement of single pixel. Background, Foreground and intensity of light does not effect this method. Camera used in this method captures only moving object pictures. There is no concept like regular recording that's by it save the memory. This method takes less time rather than colour based method. Colour method time varies between 55ns and 73ns but Graph's axis change method takes the time between 8ns and 50ns. This is shown in results.

6. Conclusion and Future work

The proposed algorithms are simulated using .NET FRAMEWORK 4.0, VISUAL C# on different images in video surveillance. In this paper two algorithms are implemented. Graph's axis change algorithm is implemented for removing the following disadvantage of space vector difference method in colour images. (a) When the background and the current object have same colour then moving objects are not detected. (b) Colour method depends upon intensity of light. In other way, there is no need to take the background model in graph's axis change method because it only depends on the current pixel's movement according to axis. Secondly change in intensity of pixel does not affect the movement of pixel in second method. In future our focus is on camera quality and SIM card programming with mobile for creating a call.

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