A NOVEL APPROACH FOR REAL TIME MOVING OBJECT DETECTION

Gagandeep Kaur
Department of Computer Engineering, YCOE, GuruKashi Campus, Punjabi university, Talwandi Sabo, Punjab, INDIA
manshahia.gagan@gmail.com

Sumeet Kaur
Department of Computer Engineering, YCOE, GuruKashi Campus, Punjabi University, Talwandi Sabo, Punjab, INDIA.
purbasumeet@yahoo.co.in

ABSTRACT

Detection of moving objects from video frames plays an important and often very critical role in different kinds of machine vision applications including human detection and tracking, traffic monitoring and military applications. A common way to detect moving objects is background subtraction. In background subtraction, moving objects are detected by comparing each video frame against an existing model of the scene background. In this paper, we proposed an axis based algorithm for detection of moving objects. The algorithm is based on position of pixels according to x axis and y axis. Each pixel in an image takes some value. The algorithm operates in real-time under the assumption of a stationary camera. It can handle all multiple backgrounds because it does not follow the concept of background and foreground. It only depends upon the movement of pixel according to x axis and y axis. This algorithm also reduces time (T) taken in detection of moving objects.

Keywords - Motion detection; Graph axis; Background and foreground model.

1. INTRODUCTION

In recent years, motion detection has attracted a great interest from computer vision researchers due to its promising applications in security area such as banks, highway [2] and in traffic monitoring [6]. However, it is still in its early developmental stage and needs to improve its robustness when applied in a complex environment. Sensors which detect the moving objects used in almost all video surveillance applications. Visual cameras are easy to
install and maintain [13]. Object detection is a most important step in image processing but very difficult to accomplish. Several techniques for moving object detection have been proposed. In among them, the three representative approaches are temporal difference, background Subtraction [12] and optical flow [11]. Temporal differencing [4] 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. This method is highly adaptive to dynamic environments, but generally does a poor job for extracting the complete shapes of certain types of moving objects. Background subtraction [10] is the most commonly used approach in presence of fixed camera [5]. The principle of this method is to use -a model of the background [7] 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 [7]. 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 [3] accurately even without knowing the background [8]. In this paper we have a new method called graph’s axis change method. This method prohibits the use of background model.

2. **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 Block matching [9], optical flow method and colour method [1]. 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.

3. **IMPLEMENTATION OF GRAPH’S AXIS CHANGE METHOD**

3.1 **Algorithm Steps**

(a) Fetch a VGA (Visual Graphic Adapter) camera.
(b) Read the original Image of standard size 640x480 taken from video surveillance.
(c) Read the value of pixel according to x and y axis.
(d) When the pixel moves from initial position, take the value of pixel at new position using derivatives $X = X + \Delta X$, and $Y = Y + \Delta Y$ with respect to their time limits.
(e) Divide the new value of pixel to old value of pixel according to x axis and y axis.
(f) Find the velocity using x and y components.
(g) Set the value of threshold from 0.95 to 1.05.
(h) Compare the magnitude of velocity with threshold value.
(i) If this value lies between threshold limits then moving object is detected and alarm is generated.

In video surveillance we take the pictures of scenes using a camera. The original picture is divided into 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.

\[ \text{Velocity} = \frac{\text{distance}}{\text{time}} \]

\[ V = \left( V_x^2 + V_y^2 \right)^{\frac{1}{2}} \]

**Figure 1** Position of pixel in an image according to x axis and y axis.

Consider a pixel of a moving object at point A (pixel coordinates (x, y) at time t) with image brightness equal to 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.
Figure 2. Movement of pixel form one position to other with respect to their derivatives

The brightness constancy assumption thus results in the following equation:

\[ I(x, y, t) = I(x + dx, y + dy, t + dt) \] \hspace{1cm} (1)

Using Taylor series [8] expansion (only consider first order terms) the right hand side of the above results.

\[ I(x + dx, y + dy, t + dt) = I(x, y, t) + \frac{\partial I}{\partial x} dx + \frac{\partial I}{\partial y} dy + \frac{\partial I}{\partial t} dt \] \hspace{1cm} (2)

\[ \frac{\partial I}{\partial x} dx + \frac{\partial I}{\partial y} dy + \frac{\partial I}{\partial t} dt = 0 \] \hspace{1cm} (3)

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

\[ \frac{\partial I}{\partial x} dx/dt + \frac{\partial I}{\partial y} dy/dt + \frac{\partial I}{\partial t} dt = 0 \] \hspace{1cm} (4)

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

\[ \frac{dx}{dt} = u \] \hspace{1cm} (5)
\[ \frac{dy}{dt} = v \] \hspace{1cm} (6)

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

\[ \frac{\partial I}{\partial x} u + \frac{\partial I}{\partial y} v = -\frac{\partial I}{\partial t} \] \hspace{1cm} (7)

According to Lucas Kanade method [8] we take is equation as

\[ \frac{\partial I}{\partial x} = I_x \] \hspace{1cm} (8)
\[ \frac{\partial I}{\partial y} = I_y \] \hspace{1cm} (9)

We put these values in equation (7)

\[ I_x u + I_y v = -I_t \] \hspace{1cm} (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.

4. RESULT AND DISCUSSION

- Movement of pixels along only x axis
  (a) Input image (640×480) when there is no movement and all objects are in static positions. This is shown in Frame 1.
- Value of pixel according to x axis= 0
- Value of pixel according to y axis = 0
- Time at initial position = 0, means no movement of pixel is there

Frame 1

(b) Outputs when the person moves from one position to another position according to X axis and security alarm is generated. Here a new value of pixel along x axis is calculated which is given by X+ΔX in time T+ΔT.
- Pixel position 0 to 20, New Value of pixel = 20.
- Time domain changes from 0 to 10. New value of time = 10 ns
  \[ X+\Delta X = 20, \ Y=0 \]
  \[ \text{Velocity} = \frac{20}{10} = 2 \text{m/s} \]
  Velocity shows movement of pixel. Frame 2 shows the change in pixel position according to x axis at time 10 ns.

Frame 2

(c) Now ΔX is old position of pixel according to x axis and shown by x, When pixel moves from this old position (x = 20) position to new position (ΔX = 60), It takes the time 50 ns. Now time domain changes from 10 ns to 50 ns. This is shown in Frame 3.

\[ X+\Delta X = 60, \ Y=0 \]
(d) When the person movement becomes slow Graph’s position according to time domain comes down. There is decrement in position of pixel according to x axis and Time domain also decreases from 50ns to 20ns.

- Now new value of Pixel ($\Delta x$) is 20 at time ($\Delta t$) 20. This is shown in Frame 4 and Frame 5. $X+\Delta X=20, \quad Y=0$

(e) Pixel moves from old value to new value and gives a variation in time. This is shown by these pictures. Now new value of pixel is 19 and time taken to reach the pixel at this position is 8ns.

**POSITION TIME GRAPH (A)**- Movement of pixels with in time along only X axis. There is no movement in vertical plane.
Here position time graph shows the value of pixel movement according to Time change. Blue line shows value of time change and Yellow line shows the movement of pixel from its position. Sharp Edges of blue line in graph shows suddenly variations in time when, the pixel moves its lower position to higher position. Degradation of lines in Graph shows decrease in time when, the pixel value shift from higher position to lower position. One thing should be in mind when, the new value of pixel is updated Position Time graph and values of pixel and time taken in table is automatically generated. Position time graph gives different values of pixel and time domain at all time when a person passed in-front of camera.

Table 1 values of time according to pixel change

<table>
<thead>
<tr>
<th>tm</th>
<th>pix</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>19</td>
</tr>
</tbody>
</table>

- Movement of pixels along y axis.

Now pixel movement is shown in vertical direction where the pixel Change their position along y axis.

(a) Input image (640×480) from video surveillance when, there is no movement. Camera and other objects are in static position. This is shown in Frame A1.

X=0, Y=0
(b) When there is a movement of hand in vertical direction, at that time value of $y$ changes from 0 to 15. This is shown in Frame A2.

- Now new value of $X = 0$, because no movement in horizontal direction.
- New Value of $y$ is $\Delta y = 15$. Here $\Delta y$ represents new value of pixel and $y$ represents old value of pixel.
- Time domain ($T$) changes from $t = 0$ to $\Delta t = 18$.

Frame A2.

POSITION TIME GRAPH (B) - The movement of pixels along Y axis

In this Position-Time Graph, Value of pixel in vertical plane is shown. As soon as pixel moves from lower position to higher position there is a change in time domain.

Table 2. Pixel position and time taken to change the position
Table 3. Comparison of Graph’s axis change method with colour method

<table>
<thead>
<tr>
<th>Value of x</th>
<th>Value of y</th>
<th>Position of pixel</th>
<th>Time taken by colour method T(ns)</th>
<th>Time taken by Graph’s axis change method T(ns)</th>
</tr>
</thead>
<tbody>
<tr>
<td>X=0</td>
<td>Y=0</td>
<td>0</td>
<td>44</td>
<td>0</td>
</tr>
<tr>
<td>X=5</td>
<td>Y=0</td>
<td>15</td>
<td>48</td>
<td>18</td>
</tr>
<tr>
<td>X=7</td>
<td>Y=0</td>
<td>11</td>
<td>55</td>
<td>20</td>
</tr>
<tr>
<td>X=12</td>
<td>Y=7</td>
<td>16</td>
<td>50</td>
<td>21</td>
</tr>
</tbody>
</table>

Graph’s axis change method is compared with colour based method [1] on the basis of time that a pixel taken to change its position. Zhen Qian [1] gave a method called space vector difference method for detection of moving objects. He gave good results but our environment is totally different for implementing the colour method. Colour method depends upon intensity of light. Light effect plays an important role. We implemented this method in a room having light effect. We can see from this table Graph’s axis change method takes less time than colour method and Time is zero when there is no movement of pixels (x=0, y=0). On the other hand colour method takes 44 ns when there is no movement because there is so much fluctuations in colour method due to intensity of light. Graph’s axis change method removes the disadvantages of other method like background model and intensity of light because this method does not depend on background model and intensity of light. Application of Graph’s axis change method is in security area like Banking.

- **Discussion**
  This algorithm detect the moving objects according to change in pixel position. It easily captures the moving objects because it does not depend on background model. Secondly the intensity of light can not effect this method, as in colour method. So this method gives an accurate result in detection of moving objects. A fixed camera is used in this method which detects only those images in video surveillance when the object is passed. There is less hard disk is used because there is no such concept of regular recording so it saves the memory. Time taken by this method is between 8ns to 50 ns which, is less than space vector difference method. Less time consumed increases the speed of a system. This algorithm gives best result in a small unit of time.

5. **CONCLUSION AND FUTURE WORK**

The proposed algorithms are simulated using .NET FRAMEWORK 4.0, VISUAL C# on different images in video surveillance. Graph’s axis change method is implemented for removing the following disadvantage of other techniques. (a) When, the background and the current object have same colour then moving objects are not detected in space vector
difference method. (b) Colour method depends on intensity of light. (c) Background subtraction method only works when the background is fixed. In other way, Graph’s axis change method removes the first disadvantage having same colour because it takes only movement of pixel. Background and object colour does not affect it. Brightness (intensity of light) can not change the position of pixels. 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. If there is change in background, this does not affect this method. In future our focus is on camera quality and SIM card programming with mobile for creating a call.

REFERENCES