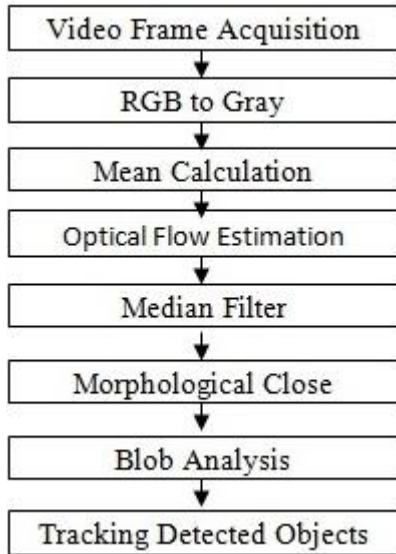




- 7) Use median filter to get threshold image of moving object.
- 8) Perform blob analysis on thresholded.
- 9) After that box can be drawn around that image.
- 10) Moving object tracked in that box.

The main steps used are optical flow and thresholding, median filter and blob analysis.



**Figure 2:** Block Diagram for Proposed Algorithm

**A. Optical Flow**

Optical flow method involves calculating the image optical flow field and doing clustering processing according to the optical flow distribution characteristics of image. This method can get the complete movement information of an object and it is useful for detecting the moving object from the background with the 85% accuracy, but this method has a few disadvantages including large quantity of calculations, sensitivity to noise, poor anti-noise performance, which make it not appropriate for real-time object detection and tracking. Optical flow estimation tries to assign to each pixel of the current frame a two-component velocity vector indicating the position of the same pixel in the reference frame. There are several optical flow estimation algorithms known in the literature. According to the taxonomy proposed in, we can cluster algorithms in the following categories: region-based matching, differential (Lucas-Kanade, Horn-Schunk) and energy-based algorithm. Optical flow method generates optical flow field for every pixel in sequential images, in which the velocity and direction of every pixel are obtained.

**Estimation of Optical Flow:**

Optical flow method generates optical flow field for every pixel in sequential images, in which the velocity and direction of every pixel are obtained. Given an image  $I$  and  $I(x, y, t)$  represents the gray value of pixel  $I(x, y)$  at time  $t$ . Let  $(u, v)$  represent the optical flow components of  $I(x, y)$ . Suppose that pixel  $I(x, y)$  at time  $t$  moves to  $I(x + \Delta x, y + \Delta y)$  at time  $t + \Delta t$ , where  $\Delta x = u * \Delta t$  and  $\Delta y = v * \Delta t$ , and the gray value of  $I(x, y)$  and  $I(x + \Delta x, y + \Delta y)$  are the same. So we get the equation below:

$$f(x + \Delta x, y + \Delta y, t + \Delta t) = f(x, y, t) \tag{1}$$

Using Taylor series expansion, the equation becomes

$$f(x, y, t) + \Delta x \frac{\partial f}{\partial x} + \Delta y \frac{\partial f}{\partial y} + \Delta t \frac{\partial f}{\partial t} = f(x, y, t) \tag{2}$$

Divided by  $\Delta t$ , and let  $\Delta t$  tend to zero, then get the equation below:

$$\frac{dx}{dt} \frac{\partial f}{\partial x} + \frac{dy}{dt} \frac{\partial f}{\partial y} + \frac{\partial f}{\partial t} = 0 \tag{3}$$

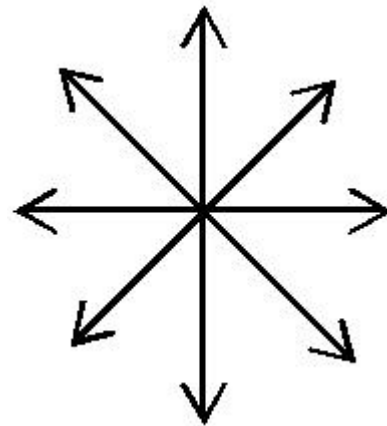
For simplicity of expression, give some variable definition.

let  $u = \frac{dx}{dt}, v = \frac{dy}{dt}, f_x = \frac{\partial f}{\partial x}, f_y = \frac{\partial f}{\partial y}, f_t = \frac{\partial f}{\partial t}$

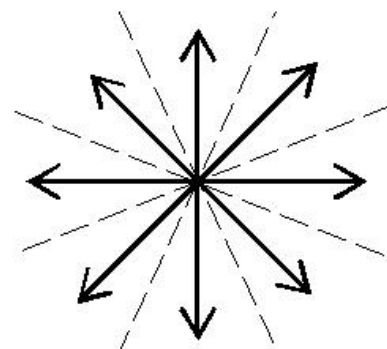
Then the optical flow constraint equation becomes

$$uf_x + vf_y + f_t = 0 \tag{4}$$

In this equation  $f_x, f_y$  and  $f_t$  can be easily got from the image. And with other constraints, we can get the value of  $u$  and  $v$ . The moving speed of every pixel in axis  $x$  and  $y$  is got from optical flow method. If given two continuous frames, optical flow method can be used to calculate the moving speed and direction of every pixel that move from the first frame to the second frame. Dividing the whole region into eight sub-regions as shown in Fig. 1, we get eight moving directions. As shown in Fig. 2, region between two adjacent dotted lines belongs to the same direction. Given the target region, then the moving direction is determined by voting method.



**Figure 3:** Eight sub-regions of the whole region



**Figure 4:** Direction Determining Method

**B. Thresholding**

Thresholding is the simplest method of image segmentation. From a grayscale image, thresholding can be used to create binary images.

1.) Method

During the thresholding process, individual pixels in an image are marked as "object" pixels if their value is greater

than some threshold value (assuming an object to be brighter than the background) and as "background" pixels otherwise. This convention is known as threshold above. Variants include threshold below, which is opposite of threshold above; threshold inside, where a pixel is labeled "object" if its value is between two thresholds; and threshold outside, which is the opposite of threshold inside. Typically, an object pixel is given a value of "1" while a background pixel is given a value of "0." Finally, a binary image is created by coloring each pixel white or black, depending on a pixel's labels.

**2.) Threshold Selection**

The key parameter in the thresholding process is the choice of the threshold value. Several different methods for choosing a threshold exist; users can manually choose a threshold value, or a thresholding algorithm can compute a value automatically, which is known as automatic thresholding value, the rationale being that if the object pixels are brighter than the background, they should also be brighter than the average. In a noise less image with uniform background and object values, the mean or median will work well as the threshold, however, this will generally not be the case. A more sophisticated approach might be to create a histogram of the image pixel intensities and use the valley point as the threshold. The histogram approach assumes that there is some average value for the background and object pixels, but that the actual pixel values have some variation around these average values.

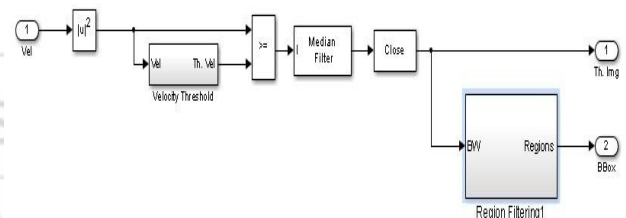
**C. Median Filtering**

In signal processing, it is often desirable to be able to perform some kind of noise reduction on an image or signal. The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical preprocessing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically.

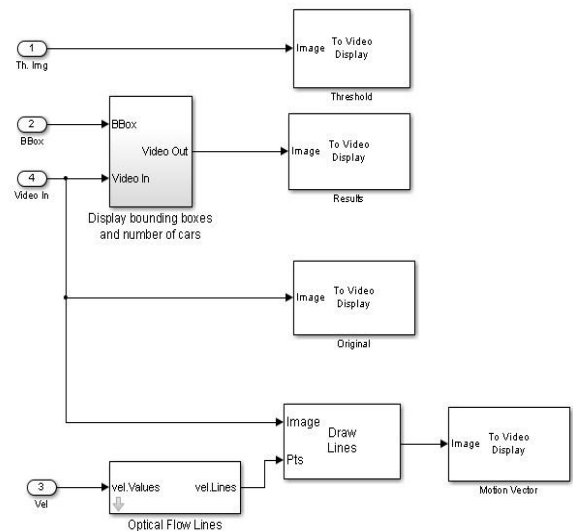
**D. Blob Analysis**

In the area of computer vision, blob detection refers to visual modules that are aimed at detecting points and/or regions in the image that differ in properties like brightness or color compared to the surrounding. There are two main classes of blob detectors differential methods based on derivative expressions and methods based on local extreme in the intensity landscape. With the more recent terminology used in the field, these operators can also be referred to as interest point operators, or alternatively interest region operators.

There are several motivations for studying and developing blob detectors. One main reason is to provide complementary information about regions, which is not obtained from edge detectors or corner detectors. In early work in the area, blob detection was used to obtain regions of interest for further processing. These regions could signal the presence of objects or parts of objects in the image domain with application to object recognition and/or object tracking. In other domains, such as histogram analysis, blob descriptors can also be used for peak detection with application to segmentation. Another common use of blob descriptors is as main primitives for texture analysis and texture recognition. In more recent work, blob descriptors have found increasingly popular use as interest points for wide baseline stereo matching and to signal the presence of informative image features for appearance-based object recognition based on local image statistics.

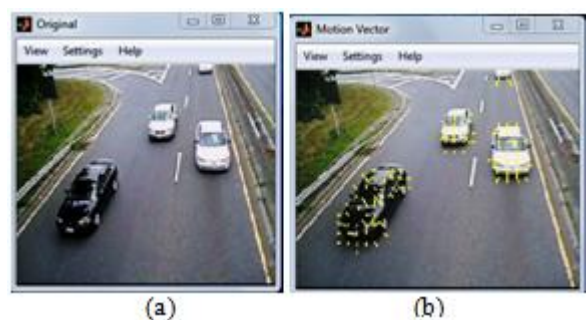


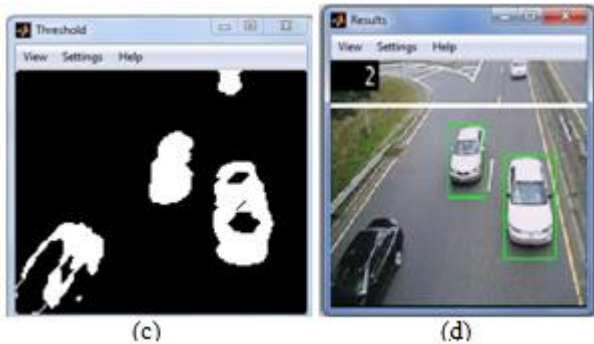
**Figure 5: Simulink Block Diagram for Thresholding and Region filtering**



**Figure 6: Simulink Block Diagram for Display Result**

**4. Result**





**Figure 7:** An Urban Video Frame (a) Original input video frame (b) optical flow motion vectors, (c) binary image with blobs and (d) tracking motion vehicles with boundary boxes

Table I depicts the average processing times (in ms) of proposed framework when applied on a 120- frame-video and RGB(120× 160) Image format using matlab.

**Table 1:** Average Processing Time (in ms) of Various Stages Within Framework

Stages	Lucasnade	HornSchunk
Optical flow estimation	5.2	6
Filtering Segmentation	1.6	1.6
Motion Vectors Computing	.44	.58
Tracking + Count Number	11.3	11.3
Initializing and Finalizing	5534.4	6201.1
<b>Total</b>	<b>5,552.9</b>	<b>6,220.5</b>

## 5. Conclusion

This paper has presented a system for motion object detection and tracking in image sequences from aerial or stationary camera images. Traffic surveillance in the urban environment is one of the most applicable usages of this system. The proposed system employs several methods to detect, filtering, segmentation and tracking objects. We used Lukas- Kanade algorithm, as the most suitable method of optical flow estimation, to detect moving objects by the intensity changes of frames. The median filter performance significantly surpasses that of the other filters under study. The morphological close extracted significant features of region shapes from binary images and then blob analysis introduced these shapes to the next step's foregrounds. A great advantage of blob analysis is the low computation cost. Finally, as shown in the experimental result, the system is able to remove unwanted motion object which are not vehicles in the image sequence, using constraints on blob areas.

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