# Application of algorithms for searching motion in the frame for the detection of vehicles

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***Abstract:*** *In the paper discusses methods for detecting moving objects in the video stream. It is proposed combined algorithm applied to the detection of vehicles. The results of testing under real conditions revealed a fairly high percentage of detection in order to be able to apply it in the detectors of transport.*

**Keywords:** video detection, detection of vehicles, image processing.

## ACTUALITY AND EXISTING SOLUTIONS

The use of video detection systems in traffic controllers can determine the flux density of vehicles on the lanes, speed and belonging to a class, as well as to video review from any selected camera in real time, to collect and process the accumulated data, to manage the detection region.

Using video detection ensures effective management of road traffic and pedestrian flows in cities with the help of traffic light signal, video monitoring and recording of violations on the roads, traffic control route of transport. To date, there are different approaches to search for motion in the frame. Methods of background subtraction [1], methods of computing optical flow [2,3]. In this paper we propose a search algorithm for motion, combining these two approaches to achieve better results.

### The method of background subtraction.

Consider the essence of an algorithm based on a comparison of two successive images. Define [2] frame images taken at the time as $t_i$, a set of points $I_i$, and frame images taken at the time $t_i + 1$ as a set $J_i$. Let $c_i(x, y)$ - a function of brightness of the image point defined on the sets $I_i$ and $J_i$. One of the simplest approaches to identify areas of motion between two image frames, and is based on a comparison of the relevant points of these two frames. For this purpose, the procedure of forming the so-called difference frames. Difference between the two image frames, taken at the times $t_i$ and $t_j$ is the following set:

$$F(i,j) = \begin{cases} | I(i,j) - J(i,j) | \le \theta, \\ | I(i,j) - J(i,j) | > \theta. \end{cases} \qquad (1)$$

where $\theta$ - the threshold level is chosen so as to separate the points at which the image frames are significantly different from each other (due to the motion to recognize objects) from the points at which the time $t_i - t_j$ there was a slight noise fluctuations of brightness.

### The method of optical stream.

To determine the moving dots and the nature of their movement, you can use an optical flow image series [3]. Optical stream is defined as the apparent motion of image brightness. Let the image brightness $I(x, y, t)$, which varies in time, ie we have a sequence of images. We make two assumptions:

The brightness of the image $I(x, y, t)$ depends on the coordinates $x, y$.

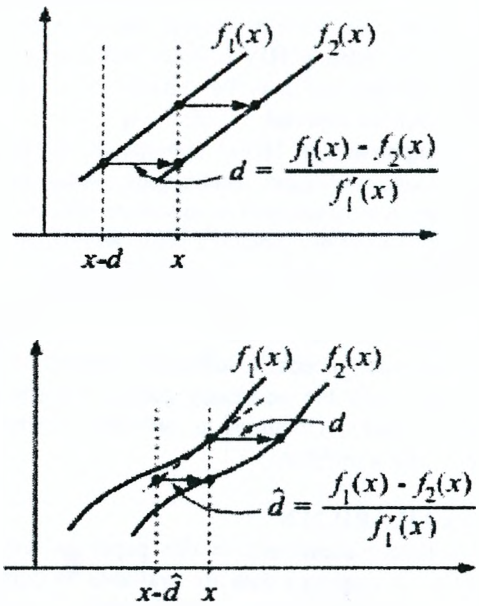


**Fig. 1 - Search for optical stream**

The brightness of each point of a moving or static object does not change over time.

Based on these assumptions, the equation is written

$$-\frac{\partial I}{\partial t}=\frac{\partial I}{\partial x}u+\frac{\partial I}{\partial y}v \qquad (2)$$

referred to as the optical flow equation, where $u$ and $v$ are components of optical stream in the coordinates $x, y$, respectively.

Since equation (2) has more than one solution, it requires a greater number of equations. Using the equation for optical stream fields associated pixels, and assuming that they have the same speed, the problem of finding optical stream can be reduced to solving a system of linear equations. It decision to give the speed of movement-related areas of pixels.

## COMBINED ALGORITHM FOR SEARCH OF MOTION

For the organization of the detection algorithm was designed to find differences on several consecutive frames. This algorithm is characterized by simplicity and efficiency, as the analysis of small sequence of frames for changes, and after finding the changes in the search - the window - is reduced to reduce the calculations and the stress on computational tools.

The algorithm allows sufficiently accurate for solving the problem to detect objects, spending a minimum of computing resources.

Initial data for the algorithm is a frame-image obtained from a camera, and a threshold difference in the images.

Search algorithm for motion detection of vehicles is in the following sequence of steps:

Step 1. To analyze the difference image algorithm obtains the current system time, which is used for statistical changes in the number of images.

Step 2. Initializes the auxiliary image to mask the detection segment of the search traffic. Preservation or initialization of previous frames, which are necessary to find the difference.

Step 3. Implementation of the transformation of the transferred frame from a full color palette in the gray half-tone.

Step 4. The initial search for a component of motion on a frame by comparing two consecutive frames. Approach to identify areas of motion between two image frames $I_t$ and $J_t$, comparing the respective points of these two frames. For this purpose, the procedure of forming the so-called difference frames. To do this, set the threshold level. The correct choice of the threshold value depends on the quality of motion detection, so this algorithm, the value is chosen adaptively at each iteration so as to separate the points at which the image frames are significantly different from each other (due to the motion to recognize objects) from the points at $t_i - t_j$ which a while there were minor differences of luminance noise. To do this, save all of the threshold value at the previous iteration of the algorithm, and to determine the new values are averaged last 10 values. The problem of choice of the initial threshold value decided by the operator.

Step 5. Processing sub picture to eliminate small changes - the noise in the images. Noise filtering is performed using a threshold filter and the selection of the optimal (experimentally chosen in the experiments), the threshold value.

Step 6. Saving changes found to further adjust the motion of the object.

Step 7. Konvertatsiya images with a dedicated movement to the blue color component.

Step 8.Raschet component of motion along the optical flow for the correction of the results of the previous stage. Using the optical flow equation (2) for areas related pixels, and assuming that they have the same speed, is finding the optical flow as a system of linear equations at each step.

Solution is built-in library used by OpenCV. The outcome of the decision is the speed of movement-related areas of pixels.

Step 9. As a result of step 4, and 8 is a sequence of refinement of the components of motion in their number.

Step 10. Processing each component separately.

Step 11.Poluchenie targeting the detected object. Filtration of small changes. Designation on the received frame of a moving object found in red circle. Draw a circle in the direction of the vector object.

The above algorithm is implemented in view of the mathematical and algorithmic features of the library used by a computer vision OpenCV.

## RESULTS OF ANY TESTING OF ALGORITHM.

Testing the video detection module took place at the crossroads with no connection to the road to the controller. For testing was connected camera to a mobile computer and tested the module detection.

Tests were carried out as follows. The input video stream fed to the software module. This module detects vehicles and counts the number of vehicles, then getting the intensity of vehicles q. With the help of an infrared sensor calculates the amount of actual having moved the vehicles.

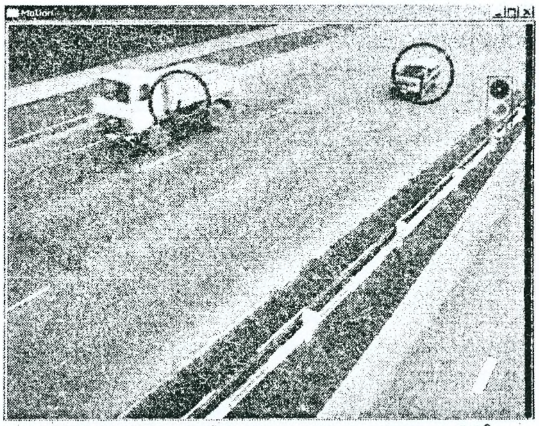

**Fig. 1 - The frame for processing at 30°**

Based on this information determines the percentage of success of detected vehicles.For the experiments use an inexpensive webcam Canyon CNR-WCAM820. Software running on your computer with the following parameters: CPU Intel Celeron 1.9 GHz,1GB memory, operating system Windows XP SP2.

All the results of detection are presented in table 1, which indicates the actual number of vehicles, the detected number of vehicles, the percentage of detection.

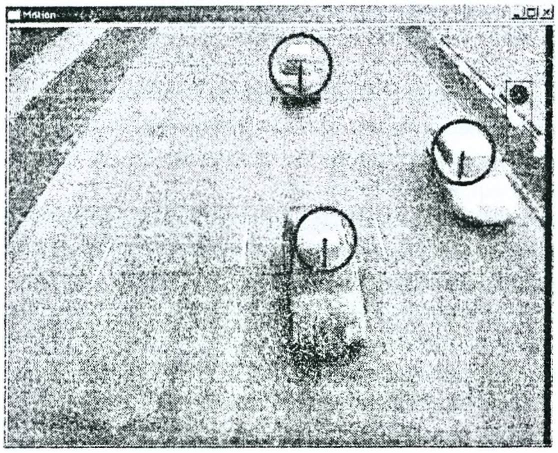

Fig. 2 - The result of selecting an area of motion in the frame

In the testing was carried out verification module to determine the degree of detection of transport in different cases.

When transportation is uniformly stretched the bands, and moves with average speed, pulled into the pack, moving at high speed. If different versions of detector above the roadway and at different altitudes.

**Table 1. Test results**

| № | The time interval of the experiment | The actual number of vehicles | Number of detected vehicle | The percentage of detection, % |
|---|---|---|---|---|
| 1 | 0:00 – 0:10 | 4 | 3 | 75,3 |
| 2 | 0:10 – 0:20 | 1 | 1 | 100 |
| 3 | 0:20 – 0:35 | 1 | 1 | 100 |
| 4 | 0:00 – 0:15 | 1 | 1 | 100 |
| 5 | 0:15 – 0:30 | 5 | 4 | 80 |
| 6 | 0:30 – 0:40 | 3 | 3 | 100 |
| 7 | 0:00 – 0:20 | 5 | 4 | 80 |
| 8 | 0:20 – 0:50 | 8 | 7 | 87,5 |
| 9 | 0:50 – 0:90 | 7 | 6 | 85,7 |
| The average value per detector | | | | 89,8 |

Detection was carried out under a wide range of angles to the road surface. It was determined the optimal location of video-detector, which is directly above the location of its required bandwidth, but also allows mounting to the side of the roadway at a height of 5-7 meters. Location is the optimum angle of 45 degrees to the plane of the canvas.

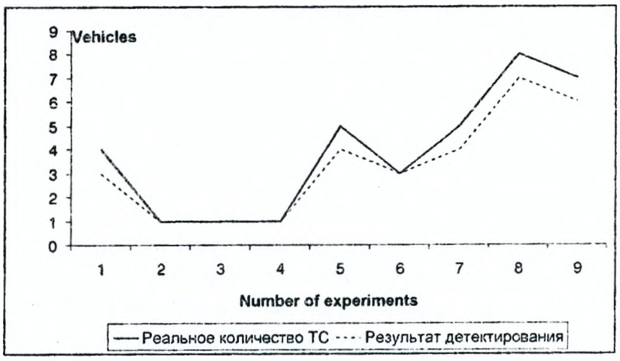


**Fig. 3-The quality of detection of vehicles**

## CONCLUSION

As seen from the tests, the system performs the detection of vehicles with the percentage of detection of 89%. In tests to assess the ability of diverse detection were used worst test examples. When installing the system on a real crossroads, the conditions attaching the camera, the location of cameras will be greatly improved, but severe deterioration in weather conditions will greatly influence the detection process, since the algorithm does not provide special protection. This was done to reduce the computational complexity of the system.

As a result, it may be noted that the system is well managed with low-quality video streams with a high rate of detection. Weather conditions in the detection experiments were the best, which affected the test results. The solution to the problems of interference during rain and snow is correctly configured, the sensitivity of detection module, which allows you to change the sensitivity of the system in large borders. Made such a setup should be intellectually for every type of weather.

## REFERENCES

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