Mathematical Problems of Computer Science 39, 125--128, 2013.

Moving Objects Detection on Colored Video Images

Suren B. Alaverdyan

Institute for Informatics and Automation Problems of NAS RA
e-mail: souren@ipia.sci.am

Abstract

The background covering formulas of images are obtained. With their help the algorithm of detection of moving objects on colored video images is given.

Keywords: image, detection.

1. Introduction

When solving various problems of colored image processing, the image is represented in a gray scale $c = (r + g + b)/3$ or $c = 0.3r + 0.59g + 011b$ to accelerate processing and reduce the used memory excluding the possible damage of the original image (loss of contour points or appearance of false contour points).

In Fig. 2 the difference between the original and the gray scale images is given, where the values of (i, j)-th point are as follows:

$$r'_{i,j} = \frac{|g_{i,j} + b_{i,j} - 2r_{i,j}|}{3}, \qquad g'_{i,j} = \frac{|r_{i,j} + b_{i,j} - 2g_{i,j}|}{3}, \qquad b'_{i,j} = \frac{|r_{i,j} + g_{i,j} - 2b_{i,j}|}{3}.$$


Fig 1. Original   Fig. 2. Difference

It is clear that the components artificially added to the original image, influence the result of the problem being solved. .

While obtaining the image in image processing theory, the image device accuracy, image quantization and, certainly, the environment which influences the formation of the image noise, are principally important. , Moreover, since for the problems the detection of objects on images or their segmentation the problem of general filters' synthesis is not solved, then in practice to solve these problems different approaches are used - -threshold restriction, brightness interval transformation, cluster analysis etc. – [1, 2].

In this article a new approach of moving objects detection on video images, obtained by a stationary camera, is given.

2. Image Background Change by Standard Image

A mathematical definition of the background does not exist, it is interpreted as the background of image [3, 4].

Let $A = \{a_{i,j}, i = \overline{1,m}, j = \overline{1,n}\}$ be an arbitrary colored image: $a_{i,j} = (r_{i,j}, g_{i,j}, b_{i,j})$, (red, green and blue colour channels of a point), and B be the standard image with the size $p \times q$. To reduce the background of the image A to the background of the image B, we find the following statistical characteristics of both images:

mean values

$$m_A = \frac{1}{mn}\sum_{i=1}^{m}\sum_{j=1}^{n} a_{i,j}\ , \quad m_B = \frac{1}{pq}\sum_{i=1}^{p}\sum_{j=1}^{q} b_{i,j},$$

mean square deviations

$$\sigma_A = \sqrt{\frac{1}{mn}\sum_{i,j}(a_{ij} - m_A)^2}, \quad \sigma_B = \sqrt{\frac{1}{pq}\sum_{i,j}(b_{ij} - m_B)^2}.$$

The general formula for the new values of the image A with the background of the image B is represented as

$$a'_{i,j} = \frac{\sigma_A}{\sigma_B}\left(a_{i,j} - m_A\right) + m_B, \qquad i = \overline{1,m}, j = \overline{1,n} \quad , \tag{1}$$

let $a'_{i,j} = 0$ if $a'_{i,j} < 0$ and let $a'_{i,j} = 255$ if $a'_{i,j} > 255$.

Below we give an example of the background change by formula (1).

Fig. 3. Original image

Fig. 4. Standard image

Fig. 5. Resulting image

Thus, the parameters $(m_A,\ \sigma_A)$ can determine the approximate value of the image background. Considering statistical moments of higher orders one can obtain a more exact value of background.

3. Object Detecting

To avoid artificially covering the image with new data (Fig. 2) we do not use in this work a gray scale image to detect objects.

There are two principal methods used to detect moving video objects on video streams: determination of image stationary part and statistical methods with threshold restriction.

In this work to detect the objects the original image is transformed into a negative image background space by formula (1) to reduce the probability of loss of dark colored objects. Since the negative mean value is equal to $255 - m_A$, the formula (1) takes the following form:

$$a'_{i,j} = \frac{\sigma_A}{\sigma_{\text{негатив}}}\left(a_{i,j} - m_A\right) + 255 - m_{\text{A}},\ i = \overline{1,m}, j = \overline{1,n}\ .$$

To obtain a binary (black-white) image, calculate the inter frame gradient using the following formula:

$$d_{ij} = max\left\{\left|a_{i,j}^{(k)} - a_{i,j}^{(k+1)}\right|,\ \sigma_{i,j}^{(k,k+1)}\right\},\quad i = \overline{1,m},\ j = \overline{1,n},$$

where

$$\sigma_{i,j}^{(k,k+1)} = \frac{1}{3}\sqrt{\sum_{p=i-1}^{i+1}\sum_{q=j-1}^{j+1}\left(a_{pq}^{(k)} - a_{pq}^{(k+1)}\right)^2}\ ,$$

k - is the frame number, (3×3) interval of (i,j) point is used. The threshold is determined as follows: $p = \frac{\sum_{i=1}^{m}\sum_{j=}^{n} d_{i,j}}{mn}$ or $p = \sigma_{Grad}$. Both of threshold values give good results.

Binary image $B = \left\{b_{i,j}, i = \overline{1,m}, j = \overline{1,n}\right\}$ is obtained as follows:

$$b_{i,j} = \begin{cases} 0, & if\ \ d_{i,j} < p \\ 1, & if\ \ d_{i,j} \geq p\ . \end{cases}$$

Below the results of object detecting algorithms are given.

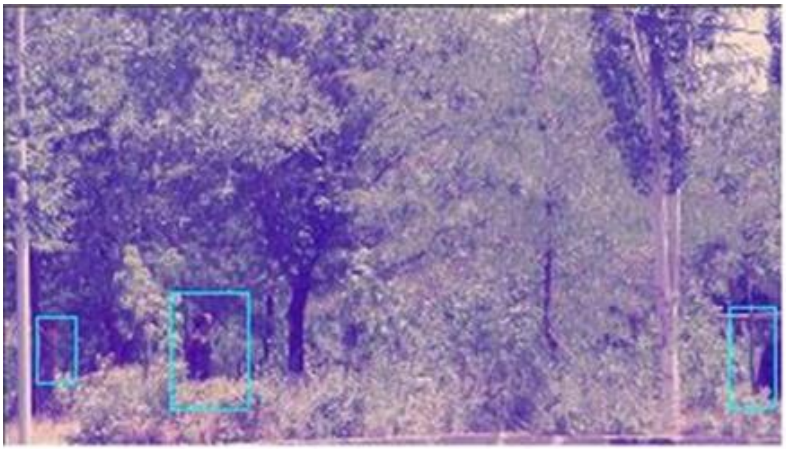

Fig. 6. Original image with negative background

Fig. 7. Objects

Fig. 8. Original image with negative background

Fig. 9. Objects

References

[1] У. Прэтт, *Цифровая обработка изображений*, *М. Мир*, т.2, 1982.
[2] T. Ko, S. Soatto and D. Estrin, "Background subtraction on distributions*", Proceedings of the 10th European Conference on Computer Vision*: *Part III,* pp. 276-289, 2008.
[3] V. Konushin and A. Konushin, "Improvement of background subtraction by mask constraints", *Proc. GraphiCon*, pp. 96-99, 2010.
[4] P Viola, M Jones, "Rapid object detection using a boosted cascade of simple features", *IEEE Computer Society Conference on Computer Vision and Pattern Recognition*, pp. 511-518, 2001.

Submitted 30.11.2012, accepted 15.02.2013.

Տեսաշարում գունավոր պատկերների վրա շարժվող օբյեկտների հայտնաբերում

Ս. Ալավերդյան

Ամփոփում

Աշխատանքում ստացված են պատկերների ֆոնային տեղափոխության բանաձևեր, բերված է նրանց կիրառության միջոցով տեսաշարում գունավոր պատկերների վրա շարժվող օբյեկտների հայտնաբերման ալգորիթմը:

Обнаружение движущихся объектов на видеоизображениях

С. Алавердян

Аннотация

Приведен новый алгоритм нахождения движущихся объектов на цветных видеоизображениях. Приведены также результаты работы алгоритма.