

Real- Time Tracking for Multiple Objects Based on Implementation of RGB Color Space in Video

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Abstract

Various algorithms based on image processing techniques have been used to detect and track objects in video surveillance systems. In this paper, followed by color RGB for multiple objects is present. To do this, real-time tracking algorithm is proposed for objects navigate and identify current positions and movements, because each object has a color with label on top. RGB color space is used to calculate the threshold values of each color. It is for example, video surveillance applications where cameras and other sources of information are used to monitor the activities of a sensitive site. Threshold values can be defined according to the object to track. Linear model is applied to the color discrimination. To remove unwanted objects to executives, morphological transformation is applied on the image binary and technical Blob analysis is then used to facilitate the detection of object. Our proposed algorithm is capable of tracking objects in the format full-frame (640 x 480 pixels) at rate (50 images per second). High performance robustness and in real time is confirmed by experiments.

Keywords: *Real-time tracking, Thresholding, RGB colorspace, Morphological operations, Blob analysis*

1.Introduction

Tracking multiple objects in video surveillance systems becomes an important task for many applications where develop fast image processing algorithms is one of the main themes of research. Different algorithms based on image processing techniques have been applied to detect multiple objects and these frequently used methods include meanshift, optical flow, Kalman, *etc* [1]. And their new applications to the national level, in the trade, or in militarily are becoming more and more sophisticated. By using image processing and computer vision techniques, the digital camera seems to have more versatile abilities to track objects. In [2] tracking of the vehicles is presented using a low-angle camera which was placed high above the ground to minimize the effect of occlusion. Based on image processing, Morphological and Blob analysis techniques have been commonly used in monitoring applications, pedestrian and human detection and in traffic surveillance systems [3]. In [4] Gaussian Mixture Model (GMM) for object tracking is used and in order to remove the noise, Morphological and Median filtering was applied. Tracking of round object is presented and to track the location of moving object Kalman filter was used [5]. But if the model is nonlinear and non-Gaussian it is not useful to resolve the tracking problem [6]. To overcome the occlusion problem an efficient L1 tracker is proposed in [7].

Colors play a key role for monitoring, detection of objects and recognition, etc, and the different color spaces such as HSV, YUV, RGB, *etc.* have been used in tracking algorithm. But unfortunately, there's no clear consensus on the color of the spaces that which one to use. Images RGB color space RGB is presented in [8]. YCbCr color and HSCbCr space is

designed to solve the problem of enlightenment and HSCBCr is applied to detection [9] the colour of the skin. Three color spaces, RGB, YCbCr and HSI are studied and after comparing algorithms based on these color spaces new algorithm is proposed in [10]. In color-based tracking, the method performed best in RGB color space in the comparison of HSI, and YUV color spaces [11]. Real-time color based tracking of head and other object is proposed in [12]. During color tracking process, color changes in different lighting conditions, although adaptive color model is used but in [13] robust tracking is achieved by Transductive Learning. Otsu method is applied on R, G, and B channel and in order to remove noise a median filtering process was proposed in color image segmentation. This method is also known to be too easy implement and also for its simplicity and high rapidity [14]. To improve the quality of image colors and detection, new spectral sharpening algorithm is proposed to produce more saturated colors [15]. Hence, Motivation of tracking increased due to different methods and color spaces. Here, RGB color space is proposed in this paper. This paper is divided into 6 sections. Section 2 covers related work. Section 3 covers RGB Color Space. Section 4 covers proposed algorithm. Section 5 covers the results and experiment. Section 6 covers conclusion and references.

2. Related Work

Color feature set is probably the most popular set in tracking because it takes less processing time to extract as compared to motion or texture extraction. In this regard, Color based tracking in robotics has been identified as one of the emerging research area. For instance, a color tagged object is possible to track by identifying its contour or color [16], and the distance of camera and object can be derived by the extrinsic and intrinsic parameters of a camera system [17], and by using video surveillance streams moving objects can be detected [18]. Using RGB color space in [19] Spartan-6 board is used to track the moving object. Real time tracking for smart cameras using Local Oriented Energy and Phase Features are achieved by using hardware [20]. In [21] a modular sensor-based mobility platform is used to track the object in real-time and it can also track the object while moving maximum speed at 5 km/hr. However, this has the drawback of being very expensive, in contrast to using the hardware. Hence on the bases of related work, we proposed our algorithm which is inexpensive and does not need any special hardware but still runs in real time. So our contribution has therefore been to unify and improve the latter approaches to build a fully automatic system able to track multiple objects in real time. Therefore, three objects were chosen and their head is tagged by red, green and blue color.

3. RGB Color Space

This section will present the fundamentals about the color space in which all video formats are based on many color spaces. For storing the different data from different images, different color spaces such as RGB, YCbCr and HSV can be used. The red, green, and blue (RGB) color space is popular color space as it's used throughout computer graphics and also chosen for experiment. By following three primary additive colors (RGB), desired color can be obtained by adding individual components. In figure 1, basic RGB color model is showed and in figure 2 three-dimensional, Cartesian coordinate system is represented. The color of the pixels in the images consists of the three additive primaries: red, green, and blue for each specific pixel. The value is called an RGB value and all possible RGB value span the RGB color space.

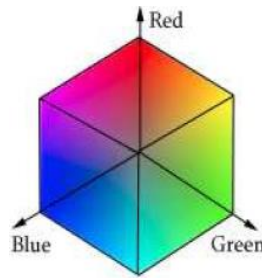


Figure 1. RGB Color Model

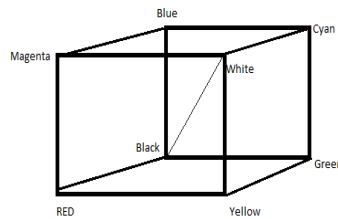


Figure 2. Cartesian System

When thresholding, Pixel values are changed in the image according to the color space intervals that define the object. Pixels that are defined as the desired object are set to 1 and pixels that are defined as non-interesting object are set to 0. In figure 2, the colors are indicated on the corners of the cube which is black at the origin. White is at the opposite end of the black color. The RGB values are on three corners of the cube, cyan, magenta and yellow are in other three corners of the cube. Maximum value of RGB color components is 255 for each color. Each color pixel in the RGB color space, where each pixel is said to have three values of (R, G, B), would have a pixel depth of 24 bits which is the number of bits used to represent a color in a particular color space [22]. In a 24-bit color graphics system with 8 bits per color channel indicates that maximum value is 255 for each color). Table 1 and 2 consist of the RGB values for 100% amplitude and 100% saturated color bars, respectively.

Table 1.100%RGB Colors Bars I

Color	Nominal Range	Green	Yellow	Cyan
R	0 to 255	0	255	0
G	0 to 255	255	255	255
B	0 to 255	0	0	255

Table 2.100%RGB Colors Bars I

Red	Black	White	Blue	Magenta
255	0	255	0	255
0	0	255	0	0
0	0	255	255	255

Luminance or brightness is considered as a concerning factor in each layer of the RGB color space. The varying level of brightness in an image causes instability and also changes the values in the RGB color space to change according to the level of brightness [23]. To overcome this challenge to remove brightness effect, decoupling technique is used to decouple the brightness from the color information [8].

According to the linear model, a full color F in every pixel at row j and column k is composed by three channels, red (R), green (G), and blue (B):

$$F(j, k) = w_{R(j,k)}R_{sat} + w_{G(j,k)}G_{sat} + w_{B(j,k)}B_{sat} \quad (1)$$

Where R_{sat} , G_{sat} and B_{sat} are the saturated color strength, and the magnitudes of RGB colors are denoted as w_R , w_G and w_B . As in the room the color and illumination was observed but magnitudes of the RGB color space also vary with different conditions such as brightness, color reflections, and shadows. Now the condition imposed on discriminating the blue tagged color which is on the head of the object can be expressed as:

$$B \leftrightarrow (B_{n(j,k)} - b_n + q_n) \geq (R_{n(j,k)} \cap G_{n(j,k)}) \quad (2)$$

Where “ n ” is the different threshold levels of pixel strength and b_n shows the tolerance in association with the blue object. Hence, to get the blue color as a target color, the algorithm in Eq.2 detects a blue patch with $(B_{n(j,k)} - b_n)$ being stronger than red and green colors and a region of interested (ROI) area is established with the corresponding pixels. On the other hand, if on the same label the green strength is lower than red and blue, the discriminating mechanism just needs to compare the strengths between red and blue.

Furthermore, in Eq. (2), we can conclude a self-adjustable discriminating boundary q_n for automatic regulation. We suppose the initial value $q_n^{(0)} = 0$ and a threshold q_n^* is chosen for a given ROI, and then q_n is updated as:

$$q_n^{l+1} = q_n^*, \text{ if } B_{n(j,k)}^l > (R_{n(j,k)}^l + b_n) \quad (3)$$

Increases gradually for the following pixel $(l+1)$ as:

$$q_n^{l+1} = (q_n^* - B_{n(j,k)}^l) + (R_{n(j,k)}^l + b_n),$$

With $B_{n(j,k)}^l \leq (R_{n(j,k)}^l + b_n)$, and

$$B_{n(j,k)}^l + q_n^l > (R_{n(j,k)}^l + b_n) \quad (4)$$

Worth mentioning here is that q_n should be reset to q_n^* if the strengths of red with tolerance b_n is weaker than blue again, and the relevant ROI will be chucked out when scanning other colors. Fluctuation of the green color could adjust the discriminating boundary automatically unless the strength of red color is significantly increased [24]. In the output stage, a filter for the blue color is included. The stray blue pixels will be considered as a random interference and hence it can be concluded by:

$$B_{(j,k)} \{1|0\} = B_{(j-1k)} \cap B_{(j-3k)} \quad (5)$$

So it is confirmed true logic “1” in an adjacent blue area while the random blue pixels are assorted as a noise with the false output logic “0”.

4. Proposed Algorithm

The aim of this paper is to implement an efficient methodology to track multiple color objects in real time. The framework is based on using the image processing steps such as thresholding, Morphological operation and color segmentation. This algorithm is implemented in Matlab. In figure 3 frame work of the proposed system is shown.

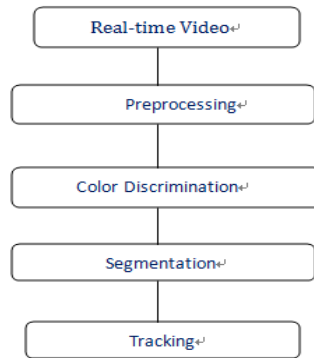


Figure 3. Frame Work of the Proposed System

Preprocessing method is used for the color conversion while thresholding is to identify all the objects in video. After computing and combining threshold values, we get a binary image with clearly identifying objects. In the next step, Morphological operation such as imfill is applied in model. After thresholding and application of the morphological process, the model creates binary feature images. For binary images, the main function is to change the connected through background pixels to foreground pixels; stopping when it reaches object boundaries. It can also be useful in removing non-required artifacts from images. Median color values of selected color were calculated. So it was simple to get the desired color after simplifying the region that had median color closed to selected color.

The model identifies the required object in binary feature image by using blob analysis block. It then shows the rectangle block around the tracked object in the video. The counter in the upper left corner shows the number of objects which have been tracked in the region of interest.

5. Experimental Results

In this Section, The experimental results are shown in figures (4), (5), and (6). A digital camera was used in the room to track and navigate the objects. Each object had the color tagged on top to navigate them. Matlab was used to perform the experiment. Red, Blue and Green color were used in the experiment. This inexpensive tracking shows that desired object can be tracked without hardware implementation. In the upper corner of the window tracked objects are displayed. Full frame size (640×480 pixels) and video frame rate (50fps) is chosen to perform the experiment.



Figure 4 .Tracking of the Moving Objects



Figure 5 . Tracking of the Moving Objects



Figure 6. Tracking of the Moving Objects

6. Conclusion and Future Work

In this research, extraction is achieved for each moving color objects such as centroid, average luminance and area. Results prove that the chosen method has better performance under dynamic conditions for real time tracking. It can be easily implemented and can be more useful for video surveillance, sports, medical applications and robotics. This research also gives other additional services such as information about location and identity of the object in true position. It is possible to track any color through this model. In future work, using the same principle applied on RGB color space, other desired colors can also be tracked.

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