# Color Space Based Objects Detection System from Video Sequences

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**ABSTRACT**

**This paper propose a statistical color model of background extraction base on Hue-Saturation-Value(HSV) color space, instead of the traditional RGB space, and shows that it provides a better use of the color information. HSV color space corresponds closely to the human perception of color and it has revealed more accuracy to distinguish shadows [3] [4]. The key feature of this segmentation method is based on processing hue component of color in HSV color space on image area. The HSV color model is used, its color components are efficiently analyzed and treated separately so that the proposed algorithm can adapt to different environmental illumination condition and shadows. Polar and linear statistical operations are used to calculate the background from the video frames. The experimental results show that the proposed background subtraction method can automatically segment video objects robustly and accurately in various illuminating and shadow environments.**

## 1. Introduction

Background subtraction is a widely used method for identifying moving and stationary objects in a video stream. It is the first significant step in many computer vision applications, including video surveillance, human motion computer and analysis, monitoring of traffic and analysis of suspicious occurrences. The performance of these applications is dependent on the background subtraction algorithm being robust to illumination changes, small movements of background elements (e.g. swaying trees, water environment handles), the addition or removal of items in the background (e.g. parked car), and shadow cast by moving objects. Computational efficiency is also of high priority as these applications generally aim to run in real-time. The most common paradigm for performing background subtraction is to build an explicit model of the background. Moving objects are then detected by taking the difference between the current frame and this background model. Typically, a binary segmentation mask is then constructed by classifying any pixel as being from a moving object when the absolute difference is above a threshold.

The rest of this paper is organized as follows. Section 2 discusses on related works of this paper. Gaussian mixture model and proposed pipeline algorithm are discussed in section 3 and 4 respectively. Section 5 shows experimental outputs of this work. Finally, Section 6 represents conclusion and future works.

## 2. Related works

There are seven methodologies on background subtraction and comparative studies among the methodologies are discussed in the paper. This original review allows the readers to compare the methods' complexity in terms of speed, memory requirements and accuracy and can effectively guide them to select the best method for a specific application in a principled way [1].

In references [2]~[8] there are many color space based method proposed with respect to different experimental environment. Especially in [3] discussed on comparative study on color base system and they used RGB, HSV, and YCrCb and normalized rgb. In this paper they conciliated that YCrCb color space is suitable for the detection of foreground and shadow in traffic image sequences and next step of the proposed study will be to study how different background modeling techniques work with different color space. In references [4] ~ [8] used HSV color space and they proved that HSV color space presented to adapt to different environment, various illumination conditions and robust to shadow.

Ming Zhao et al [3] presented robust background subtraction system base on HSV color space. Our proposed system has some similarity with this system. But they did not considered any detection concepts. We used adaptive threshold for extracting the foreground from the current frame and they used a hypothetical approach. Adrea Prati et al.[4] suggested for the future directions to include spatial information and post processing into the Sakbot system or to try ATON in the HSV color space. The Pfinder in reference [6] system in MIT used a method based on YUV color space. It performed well only with little gradual illumination changes. If the luminance changes a lot, the result is not so good. In reference [7] presented a pedestrian tracking based on HSV color space and spatial information. But it concluded about tracking features and makes the prediction of the object location and size. François et al. [8] presented an HSV color space based background subtraction technique. It can produce good results. But it subtracted only the current frame from the background model. Thus there is a lot of noise in the result. And it did not analyze the different property of each color component of the pixels and process them separately, which led to little robustness. Next section we are discussing on Gaussian Mixture Model (GMM).

## 3. Gaussian Mixture Model

An image is a matrix which each element is a pixel. The value of the pixel is a number that shows intensity or color of the image. GMM was applied to calculate the mean and deviation of paddy rice images in those five color spaces. An image is a matrix which each element is a pixel. The value of the pixel is a number that shows intensity or color of the image. Let $x$ is a random variable that takes these values. For a probability model determination, we can suppose to have mixture of Gaussian distribution as the following form

$$f(x) = \sum_{i=1}^{k} p_i \mathcal{N}(x/\mu_i, \sigma_i^2) \quad (1)$$

where $k$ is the number of regions and $p_i > 0$ are weights such that $\sum_{i=1}^{k} p_i = 1$.

$$\mathcal{N}(\mu_i, \sigma_i^2) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu_i)^2}{2\sigma_i^2}} \quad (2)$$

where $\mu_i$ and $\sigma_i$ are mean and standard deviation. For a given image X, the lattice data are the values of pixels and GMM is applied to the pixel-based model. The proposed system calculated the mean and deviation in linearly except for HSV color space. We have calculated polar mean for converting the non linear hue pixels elements to linear form.

## 4. Proposed pipeline of algorithm

In Fig. 1, presents the proposed pipeline of algorithm. The propose system consists with two main parts, background extraction and object detection. First four steps of the Fig.1 are related to background extraction and remain steps are related to object detection.

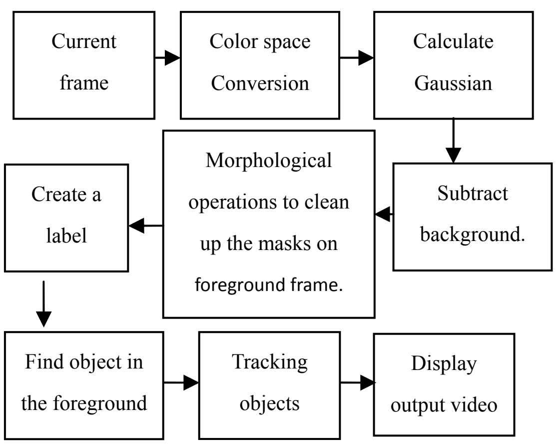


Fig. 1: Proposed pipeline algorithm

We have converted color space from RGB to HSV. As we know the HSV color space consists with polar co-ordinate system for hue, so polar statistics is used to calculate the mean and variance of the hue components. Moreover, we have calculated mean and variance for S and V color components pixels respectively. The figure on pipeline of proposed algorithm is given below.

## 5. Experimental results

For evaluating the system, video sequence with a 360x240 pixels resolution were taken. The experimental video frame rate and data was 30f/s and 65029kpbs respectively. We have considered the outdoor video at train station as our experimental data. The experimental video was very complex because the train was running in the backward direction with respect to the peoples. The train station contains much shadow by the running train. The experimental video contains two types of shadow like self shadow and cast shadow.

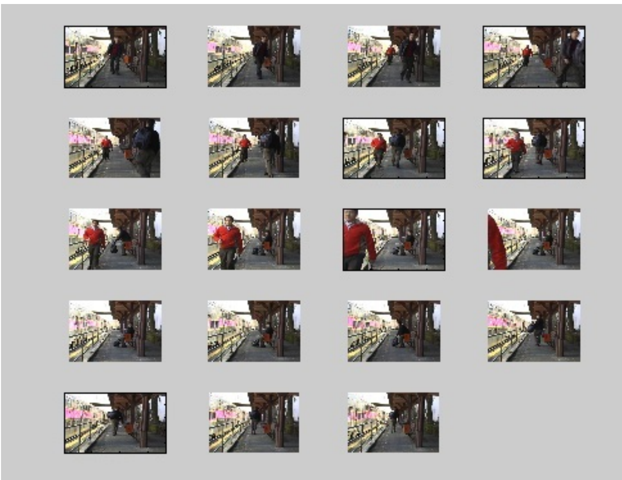

Fig.2: Input frames.

The proposed system successfully extracts the peoples from that complex background environment. In the segmentation result we have seen some false segmentation on ground section. This false segmentation is for cause of more shadow. In the future we will remove the false segmentation by using a shadow removal technique in the post processing section. Fig.3 represented the segmentation result of the foreground frame and Fig.4 is output detection and tracking of objects with specific object boundary box.

The proposed system provides the rectangular box over the specific object it may be human, or any other moving or stationary objects. It clear from the experimental results that the propose algorithm is still robust and can produce accurate result even in bad illumination condition.

Fig. 3: Foreground Extraction Outputs.

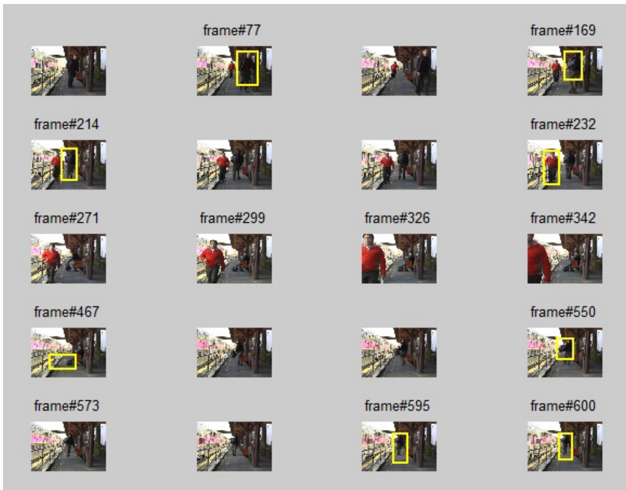


Fig. 4: Object finding and tracking output.

## 6. Conclusion and future works

This paper presented the circular nature of hue in the HSV color space and provides accurate density functions for modeling color distributions. We have described the details of the statistical foreground extraction system and objects detection method by calculating the means and variances of the pixel's of the frames. The experimental results represents that the proposed system identify the peoples as well as objects successfully. Shadow detection is considered and post processing is applied to refine the results. All the approaches contribute to the robustness of the background subtraction method. The experimental results are very satisfactory.

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