# Comparing Fixed Simple Value and Controlling Value in Otsu's Method for Outdoor Detection of Stationary Object

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## Abstract

*Most of the time the destruction is performed by using the stationary objects like a timer bomb, explosives etc. A smart surveillance system can automatically detect stationary objects in public places. It has been used in many places such as bust stops, train stations, crowded places, and popular buildings, warehouses, shipping malls, common sidewalks or airports. In the proposed system, the stationary object observation is developed for monitoring system. The system input is recorded data video files, in order to detect the stationary object in outdoor lighting by controlling and modifying image intensity value in system preprocessing and then calculate and choose the dynamic threshold value over the input image intensity value for Otsu's method. In the system preprocessing, there are in order to search and detect indoor, outdoor, day lighting in fewer errors by controlling the brightness intensity value of images. The color image processing and morphological operation are performed to get more structural elements of foreground objects in system preprocessing.*

## 1. Introduction

Several bombing attacks in public areas are happened in recent times, although we cannot stop these terrorisms but we can avoid the destruction that is caused due to terrorism. Observation of stationary or unattended objects such as bags, luggage is covered a precaution for some terrorist attacks carrying some explosive things left behind in public areas. One of the important securities monitoring systems is video surveillance system for crowded environmental areas and daily caring and monitoring system. Conventional unattended object observation methods can be separated into two approaches [7] [8] [30]. They are tracking-based methodology and observation-based approach. In the tracking-based methods, tracking foreground objects, searching for candidate static objects and observation to obtain the candidate static objects are involved [19] [26]. In the observation-based approach, using background subtraction and foreground analysis to detect the left object are included [23] [24]. In this system, unattended object observation is proposed and the system can search and detect unattended object in outdoor recorded files by using simple intensity controlled methods structural without interrupting lighting processes. The system will alert to people responsible for the role such as security guards or staffs. It can obtain many benefits in monitoring terrorisms for public life and prevent many lives from terrorism bombing attacks. The system avoids and removes dangerous or unknown objects in public areas and captures an alarm for the security guards in suspicious time. It can be efficient in video surveillance system using sharp, brightness and structrual image. The system is simple and computationally less intensive as it the use of expensive filters while achieving better detection results.

## 2. Related Works

Three steps of data processing: object extracting, involving a background subtraction algorithm which dynamically updates two sets of background. The extracted objects are classified as static or dynamic objects. It can be only interested in ROI (region of interest). The detection of abandoned or removed object achieves by contrast the color information among foreground image, current and original background. Color histograms are calculated for each of three regions using luminance channel YUV. It relies on tracking information to detect drop-off events. This system produced larger errors under bright lighting conditions [29] [1].

Gaussian Mixture Models are used for background subtraction are employed to detect static foreground regions without extra computation cost. The test and evaluation demonstrates this method is efficient to run in real time while being robust to quick lighting changes and occlusions in complex environments. The history of background objects in the scene is kept to make the matching algorithm robust to lighting changes in complex videos. The proposed algorithm is being used in real time – IBM Smart Surveillance Solutions. The wait time before triggering alarm for different lighting conditions is set as five minutes [27] [5].

It's used contrast enhancement to improve perceptibility of objects in the scene by enhancing the brightness difference between objects and their background. Next step is to use median filter to reduce noise in the images. Each successive image is subtracted from the background image, and the difference image is thresholded to be converted into a binary image. Morphological operations are affecting the form, structure or shape of an object, applied on binary images. Using Blob analysis, object detection and tracking process are occurred. The further extension is that efforts can be put in a direction to remove limitation given by static thresholds; moreover, the system can be made more robust to work under daylight or outdoor conditions [20] [4].

Object tracking and monitoring implement via the use of distributed wireless sensor networks. It proposed image and sound object tracking. The core algorithm presented detection of change algorithm for detecting a change from a given memory less and stationary process. It extended the algorithm to detect multiple repeated changes among a set of processes and proved asymptotic optimality. The algorithm has been used in various networks applications. A core algorithm presented object identification from images, audio object tracking and distributed network traffic monitoring. It is highly effective and robust, while its applications are also numerous [9] [12] [10].

## 3. Proposed System

The system can search and detect indoor, outdoor, day lighting by controlling brightness intensity of images in system preprocessing. Using Auto Threshold method in Video Processing, any noise removing methods and shadow removal are not required to reduce noise detection for background segmentation. Using Morphological Processing, the system can clearly remove structures smaller than the structuring element in a binary image.

Morphological post processing operations such as dilation and erosion are performed to reduce the effects of noise and enhance the detected regions. It provides a comprehensive solution, which can detect the status of an object, whether unattended or removed. The system receives quickly detection using Blob analysis and Core Algorithm on object statistics in 2 seconds. The system can detect and track several objects in the whole scene of the camera.

In this proposed system figure in figure 1, the recorded movie files are system input and these are converted from 'mov' to 'avi' format files. The first frame of input data file is controlled in preprocessing for recorded video files.

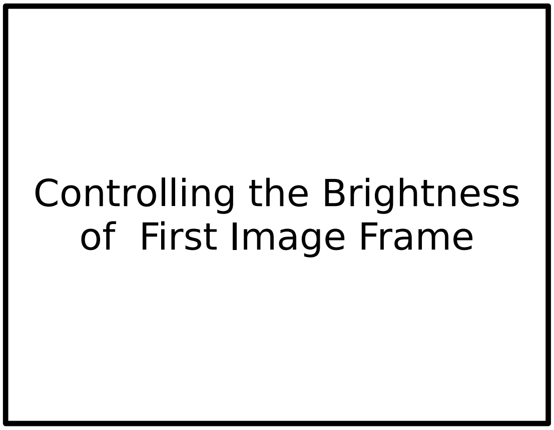



**Figure 1. The Proposed System Flowchart**

If there is for real time files, this modified step is calculated in processing loop step. So, execution time for real time files will a little long more than recorded files. The following steps of section 3.1 are controlled and modified in order to initialize threshold for Otsu's method before color space conversion step.

## 3.1. Controlling Threshold Value

The following procedure is proposed by the system to control threshold value for Otsu's method to remove many detection errors in daylights or outdoors.

1. Input Video
2. Initialize OtsuThresh ($T_o$ )
3. Read First Frame from Video
4. Compute gray level value by using ***graythresh (RGB_firstframe)***.
5. Compute mean intensity value of first frame, using ***mean2 (graylevel_image)***.
   Mean2: Sum of array elements is divided by Number of array elements
6. If mean_intensity_value < $T_M$ ($T_M$ < (Binary White Value/2))
   #For More Darkness Images (Such as Indoor).
   #Darkness value is nearer black value (zero) than white binary value (one).
   Initialize otsu_threshold = $T_o$ ($T_o > 1$)
   Initialize removed_Obj_threshold = $T_R$ ($0 < T_R < 1$)
7. Else
   #For More Brightness Images (Such as Outdoor).
   Initialize otsu_threshold = $T_o$ - (mean_intensity_value ) + x ($T_o > 1$)
   Where x is constant less than mean intensity value.
   Initialize removed_Obj_threshold = mean_intensity_value + x
   (x< mean_intensity_value )
8. Go To Color Conversion Step.

The system converts the RGB image to Y′CbCr image to reduce color space between images. It supports sharp and brightness image views. The components of Y′CbCr are Y: Luminance, Cb: Chrominance-Blue and Cr: Chrominance-Red. Luminance is very similar to the grayscale version of the original image. The system get intensity image from separating and applying three components of YCbCr of an image. For background segmentation, intensity image is converted to binary image by using Otsu's method. In this step, foreground subtraction can get more structure elements by combining morphological operation. Moreover, the system is no need to use any other noise or shadow removal methods. Blob analysis is used for foreground subtraction from complex background. It is passed several parameters to object tracking process.

The object tracking method is calculated the fractions of some parameters and start 'persistent track'. And then if the core algorithm see and catch the motion process it scans all incoming blobs and quantize the values that will be tracking. All the objects and subjects are tracked by bounding boxes with green color. This algorithm returns the bounding box with set of age blobs and then if the unattended object is found in the scene the alarm is set up showing a red filled rectangle. If the subject removed the unattended object the system will show a message box 'The removed object is found'.

## 3.2. Color Conversion

To convert the RGB image to Y′CbCr image to reduce color space between images. Y′CbCr is a family of color image pipeline in video and digital photography system. Y′ is the luma component and $C_B$ and $C_R$ are the blue difference and red difference chroma components. It supports sharp and brightness image views. Y′CbCr signals are created from the corresponding gamma adjusted RGB (red, green, blue) source using two defined constants $K_B$ and $K_R$ as follows [21] [2] [3] [6]:

$$Y' = K_R \cdot R' + (1 - K_R - K_B) \cdot G' + K_B \cdot B'$$

$$P_B = \frac{1}{2} \cdot \frac{\acute{B} - \acute{Y}}{1 - K_B}$$

$$P_R = \frac{1}{2} \cdot \frac{\acute{R} - \acute{Y}}{1 - K_R}$$

Where $K_B$ and $K_R$ are ordinarily derived from the definition of the corresponding RGB space. The prime (′) symbols mean gamma correction is being used. The resulting luma (Y) value will have a nominal range from 0 to 1, and the chroma ($P_B$ and $P_R$) value will have a nominal range from -0.5 to +0.5. Luminance is very similar to the grayscale version of the original image.

### 3.3. Otsu's Method

The system get intensity image from separating and applying three components of YCbCr of an image. Using Otsu's method, it determines the threshold by splitting the histogram of the input image to minimize the variance for each of the pixel groups. The object multiplies this scalar value with the threshold value computed by Otsu's method. The result becomes the new threshold value [25] [28]. In this system threshold Scale Factor is 1.3.

1. Compute histogram and probabilities of each intensity level.
2. Set up initial $w_i$ (0) and $\mu_i$ (0).
3. Step through all possible thresholds $t$ = 1…maximum intensity
   1. Update $w_i$ and $\mu_i$
   2. Compute $\sigma_b^2(t)$
4. Desired threshold corresponds to the maximum $\sigma_b^2(t)$.
5. Can compute two maxima (and two corresponding thresholds).
   $\sigma_{b1}^2(t)$ is the greater max and $\sigma_{b2}^2(t)$ is the greater or equal maximum.
6. Desired threshold = $\frac{threshold_1 + threshold_2}{2}$

### 3.4. Morphological Processing

It is used to fill in small gaps in the detected objects. The two basic operations, dilation and erosion, can be combined into more complex sequences. The most useful of these for morphological filtering are called opening and closing. Closing consists of a dilation followed by erosion and can be used to fill in holes and small gaps. Closing can be used to enhance binary images of objects obtained from thresholding. The closing operation has the effect of filling in holes and closing gaps [15] [18] [22].

$$A \bullet B = (A \oplus B) \ominus B$$

### 3.5. Blob Analysis

In computer vision, blob detection methods are aimed at detecting regions in a digital image that differ in properties, such as brightness or color, compared to surrounding regions. Informally, a blob is a region of an image in which some properties are constant or approximately constant; all the points in a blob can be considered in some sense to be similar to each other. The Blob Analysis is blocked to calculate statistics for labeled regions in a binary image. The block returns quantities such as the centroid, bounding box, label matrix, and blob count. One of the first and also most common blob detectors is based on the Laplacian of the Gaussian (LoG). Given an input image $f(x,y)$, this image is convolved by a Gaussian kernel [11] [13] [14].

$$g(x,y,t) = \frac{1}{2\pi t^2} e^{-\frac{x^2+y^2}{2t^2}}$$

At a certain scale $t$ to give a scale space representation $L(x,y;t)=g(x,y,t)*f(x,y)$.

### 3.6. Tracking with Core Algorithm

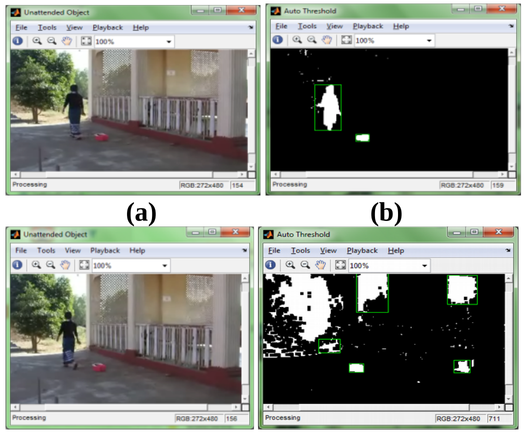
A lot of parameters from blob analysis are input to the tracking process. It turns some inputs from percentages to fractions. It declares integer valued and persistent elements of a track. The core algorithm is generally used in network sensor, network game, network traffic monitoring and robotic sensor for tracking. In core algorithm, if blobs were found, then process the tracks, scan through all the incoming blobs and quantize the values that it is being tracked. If an existing track, update existing track and create new track find first unused track, at last fill track information. It determines which objects are stationary and then should trigger alarm [16] [17] [29].

## 4. Experimental Results

The following figures in figure 2 are resulted from using simple fixed threshold for Otsu's Method in outdoor day light. The figures (2) and (3) are comparing the results of simple fixed value and dynamic value by controlling and modifying over intensity of system input image for Otsu's method.


(a) (b) (c) (d)

**Figure 2. Results of Using Fixed Simple Otsu's Method(a)Outdoor Image (b) Threshold Image (c) Outdoor Image with errors (d) Threshold Image with Errors**




**(a) (b) (c) (d)**

**Figure 3. Results of Using Proposed Controlling Brightness for Outdoor Light (a)Outdoor Image (b) Threshold Image (c) Outdoor Image without Errors (d) Threshold Image without Errors**

The system can remove these lighting errors in figure 2 initializing threshold for Otsu's method using controlled image intensity value described in section 3.1. The following figures in figure 3 are resulted dynamic threshold value controlled by image intensity value in recorded input data files.

The system can't be observed when the unattended objects have not very different intensity values with background object. And some similar color objects are not detected by this system because they have nearly same color and intensity values of each others. Sometimes mirrors have many reflections in day times. Very tiny objects such as phone, battery cannot be observed by this system.

**Table1: Comparing Results of Simple Otsu and Controlling Brightness for Outdoor Light**

| | Using fixed Simple Otsu Thresholding | Using Controlling Intensity Value |
|---|---|---|
| # of Video Clips | 8 | 8 |
| # of Events | 10 | 10 |
| # of True Positive | 8 | 10 |
| # of False Positive | 6 | 0 |
| # of False | 4 | 0 |

| | | |
|---|---|---|
| **Positive Video Files** | | |
| **# of False Negative** | 0 | 0 |
| **# of Removed Object Error** | 2 | 2 |

In table 1 the number of video clips for outdoor is 8 the other 42 video files are indoor and number of events is 10 (# of Events: no of events occurred in the test sequence, # of True Positive: number of correct observation, #of False Positive: number of incorrect observation, #False Negative: number of objects remained unobserved). The proposed controlling image intensity value is reduced the number of the incorrect detection.

However, in the some outdoor video files the background intensity is nearly black (intensity value = zero). So, the foreground object intensity value cannot appear over its background and the foreground value cannot space upon the background value. So, there are some removed object message errors. The total duration time for this system is calculated by second. The frame rate per second is 25. The total number of video files is 50. The total number of duration time in minute is 124.1667min, in hour is 2.0694hr. The total number of frames of input data video files is 186,250 image frames. So, the system is tested and observed on 186,250 image frames.

## 6. Conclusion and Further Works

In security monitoring system, it can save money, people life, destruction and worries for city life. It can prevent from dangerous terrorisms attacks. A computationally efficient and robust method to detect unattended objects in public areas is approved. Background subtraction and foreground analysis are evaluated efficiently. Due to its simplicity the computational cost is kept in low and no training steps are required. Finally, the system can discriminate effectively outdoor stationary objects by using simple proposed methods. The reliability of proposed system can be also used in public transportation areas indoor or outdoor.

The system can't detect unattended objects having lower intensity values than its background. The foreground image can't result in this time. And also the system can't detect small size objects such as phone, battery, etc. The proposed system can detect only unattended object left by the people in public area. So, the further extension may be in another concepts which is this unattended object is left by who. It will be searching the owner of the left object. And camera calibration can be used for 3D object tracking and observation.

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