Project Report on

ABANDONED OBJECT DETECTION

Submitted in partial fulfillment of the requirements

of the degree of

BACHELOR OF ENGINEERING

in

ELECTRONICS AND TELECOMMUNICATION

by

ALSTON D'ALMEIDA (ROLL NO. 17)
AISHWARYA GUPTA (ROLL NO. 33)
GAYATRI DAS (ROLL NO. 65)
ARINDAM GHOSHAL (ROLL NO. 67)

Under the guidance of

MR. KEVIN D'SOUZA

Department of Electronics and Telecommunication Engineering

St. Francis Institute of Technology, Mumbai
University of Mumbai
(2018-2019)

CERTIFICATE

This is to certify that the project entitled **"Abandoned Object Detection"** is a bonafide work of **"Mr. Alston D'Almeida (Roll No. 17), Ms. Aishwarya Gupta (Roll No. 33), Ms. Gayatri Das (Roll No. 65) and Mr. Arindam Ghoshal (Roll No. 67)"** submitted to the University of Mumbai in partial fulfillment of the requirement for the award of the degree of **Bachelor of Engineering** in **Electronics and Telecommunication Engineering** for the academic year 2018-19.

(Mr. Kevin D'souza)
Project Guide

(Dr. Gautam Shah)
Head of Department

(Dr. Sincy George)
Principal

Project Report Approval for B.E.

This project entitled ***'Abandoned Object Detection'*** by ***Mr. Alston D'Almeida, Ms. Aishwarya Gupta, Ms. Gayatri Das and Mr. Arindam Ghoshal*** is approved for the degree of ***Bachelor of Engineering in Electronics and Telecommunication*** from University of Mumbai.

Examiners:

Date:

Place:

ABSTRACT

In recent years, visual surveillance has gained importance in security, law enforcement and military applications. Due to the wide use of video surveillance systems, the amount of data that has to be monitored and interpreted has increased enormously. Nowadays, the pure mass of information that has to be handled by the operators of such systems has overgrown their capabilities. It has become vital to have in place efficient threat detection systems that can detect and recognize potentially dangerous situations, and alert the authorities to take appropriate action. The project describes a general framework that detects an unattended bag. After this an alarm will ring which will notify the concerned authorities about the unattended baggage.

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List of Abbreviations

CCTV	Closed Circuit Television
GMM	Gaussian Mixture Model
MoG	Mixture of Gaussian
SVM	Support Vector Machine

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included; we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in this submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

(Alston D’Almeida)

(Aishwarya Gupta)

(Gayatri Das)

(Arindam Ghoshal)

Date:

Chapter 1

Introduction

This is an introductory chapter of our project report. In this chapter we have mentioned the reason and motivation behind choosing this project. We have also written about the problem that we are going to tackle with the help of our project and the methodology of existing techniques. The organization of this project report is included in this chapter.

1.1 Motivation

In last decade many terrorist attacks took place at railway stations, hotels, malls, Cinema halls and at many other crowded places. Many people lost their lives. To fight with such anti-social activities government appointed multiple strategies. Video Surveillance System is one among them.

Visual surveillance systems today consist of a many cameras, usually monitored by a relatively small team of human operators. Typically, each operator watches a set of screens that cycle through views of different locations every few seconds. A survey on CCTV shows that they are mainly used for investigation of case rather than monitoring live footage of CCTV for crime prevention and security enforcement. That was the primary issue why it did not help to avoid terrorist attacks. Another reason behind that was limitation of human to response highly sensible situation.

Studies have shown that the average human can focus on tracking the movements of up to four dynamic targets simultaneously. Human eyes are not effective for looking at multiple displays at a time. It appears that there are spatial and temporal limits to the tracking capability of humans [1]. When targets and distractors are too close, it becomes difficult to individuate the targets and maintain tracking. This difficulty in selecting a single item from a dense array, despite clear visibility, has been attributed to the acuity of attention, or, alternatively, to obligatory feature averaging. the human visual processing capability and attentiveness required for the effective monitoring of crowded scenes or multiple screens within a surveillance system is limited. So to enhance the processing of CCTV system for real time video stream abandoned object detection System was introduced. Automatic threat detection systems can assist security personnel by providing better situational awareness, enabling them to respond to critical situations more efficiently.

Many algorithms and techniques were suggested by many researchers, scientists to design an abandoned Object detection System. But most of them are practically more complex and more expensive to implement. Some uses physical components such as highly expensive filters, lasers, sonic waves etc. it is not possible to install all those cause the cost factor [2].

The proposed System is simple and effective. It avoids the Use of above expensive physical components. It simply works on background segmentation scheme. And an additional feature is added to discover the threat (human) by using a face detection algorithm. Our system essentially emulates the behavior of a human operator.

1.2 Problem Statement

With concerns about terrorism and global security on the rise, it has become vital to have in place efficient threat detection systems that can detect and recognize potentially dangerous situations, and alert the authorities to take appropriate action. Of particular significance is the case of unattended objects in mass transit areas such as railway stations, luxury hotels, temples, churches, etc. Our project recognizes the event of someone leaving a piece of baggage unattended in forbidden areas. If there is a bag that is unattended in the video then the system detects this bag and an alarm rings then appropriate course of action can be decided.

1.3 Methodology

To solve the above problem, initially we adopted Viola Jones method, but in that method we faced an issue that we could not store the centroid co-ordinates, therefore bag could not be detected. Hence we moved to Gaussian Mixture Model (GMM).

Modeling background and segmenting moving objects are significant techniques for computer vision applications. Mixture-of-Gaussians (MoG) background model is commonly used in foreground extraction in video steam. However considering the case that the objects enter the scenery and stay for a while, the foreground extraction would fail as the objects stay still and gradually merge into the background. In this paper, we adopt a blob tracking method to cope with this situation. To construct the MoG model more quickly, we add frame difference method to the foreground extracted from MoG for very crowded situations. What is more, a new shadow removal method based on RGB color space is proposed.

1.4 Organization of Project Report

This project report is organized as follows:

Chapter 2 presents the literature survey on the existing techniques for object detection

Chapter 3 provides a brief explanation of the methodology undertaken in the project

Chapter 4 is dedicated to the simulation and experimental results.

Chapter 5 presents the conclusions and future scope for this project.

Chapter 2

Literature Review

In this section, the various analysis and researches made in the field of 'abandoned object detection' and result already published, taking into account various parameters of project and the extent of the project are discussed.

2.1 Literature Review

Detection of Abandoned Objects in Crowded Environments[2], describes a general framework that recognizes the event of someone leaving a piece of baggage unattended in forbidden areas. This approach involves the recognition of four sub-events that characterize the activity of interest. When an unaccompanied bag is detected, the system analyzes its history to determine its most likely owner(s), where the owner is defined as the person who brought the bag into the scene before leaving it unattended. Through subsequent frames, the system keeps a lookout for the owner, whose presence in or disappearance from the scene defines the status of the bag, and decides the appropriate course of action. The system was successfully tested on the i-LIDS dataset.

An Abandoned Object Detection from Real time video[3] is useful for live processing as well as post processing of Video Stream. This system detects abandoned object in Highly Sensitive Area. The System works on resolution of 320*240 (QVGA). The system is Interactive in nature and works with coordination of CCTV controller. This system is implemented using dual background segmentation. The result is highly robust in nature and is self-adaptive. The system costs lower as compared to other systems which consists filters, infrared and noise detection and reduction techniques. The Abandoned object detection system is very useful in multiple environment because of its portability. The simple mathematical processing makes the system available in real time environment along with post processing.

Robust unattended and stolen object detection by fusing simple algorithms[4], a new approach for detecting unattended or stolen objects in surveillance video is used. It is based on the fusion of evidence provided by three simple detectors. As a first step, the moving regions in the scene are detected and tracked. Then, these regions are classified as static or dynamic objects and human or nonhuman objects. Finally, objects detected as static and nonhuman are analyzed with each detector. Data from these detectors are fused together to select the best detection hypotheses. Experimental results show that the fusion based approach increases the detection reliability as compared to the detectors and performs considerably well across a variety of multiple scenarios operating at real time.

Extraction of stable foreground image regions for unattended luggage detection[5] is a novel approach to detection of stationary objects in the video stream. Stationary objects are these separated from the static background, but remaining motionless for a prolonged time. The mentioned algorithm is based on detection of image regions containing foreground image pixels having stable values in time and checking their correspondence with the detected moving objects. In the first stage of the algorithm, stability of individual pixels belonging to moving objects is tested using a model constructed from vectors. Next, clusters of pixels with stable color and brightness are extracted from the image and related to contours of the detected moving objects. This way, stationary (previously moving) objects are detected. False contours of objects removed from the background are also found and discarded from the analysis. The results of the algorithm may be analyzed further by the classifier, separating luggage from other objects, and the decision system for unattended luggage detection. The main focus of the paper is on the algorithm for extraction of stable image regions. However, a complete framework for unattended luggage detection is also presented in order to show that this approach provides data for successful event detection. The results of experiments in with this algorithm was validated using both standard datasets and video recordings from a real airport security system.

The experiments performed using the real airport recordings confirmed that this algorithm works with satisfactory accuracy and is suitable for implementation in a working unattended luggage detection system. The most important drawback of this approach is that if the input data coming from the BS procedure is inaccurate, false results may be obtained.

Robust abandoned object detection using region level[6], a robust abandoned object detection algorithm for real-time video surveillance. Different from conventional approaches that mostly rely on pixel-level processing, here perform region-level analysis in both background maintenance and static foreground object detection. In background maintenance, region-level information is fed back to adaptively control the learning rate. In static foreground object detection, region-level analysis double-checks the validity of candidate abandoned blobs. Attributed to such analysis, this algorithm is robust against illumination change, “ghosts” left by removed objects, distractions from partially static objects, and occlusions.

Chapter 3

Design Methodology

3.1 Methodology

Initially we take an input in the form of a video. It is converted into frames automatically by the MATLAB software. The necessary actions are performed on individual frames. We take two versions of this video. One is foreground extraction using Gaussian Mixture Model (GMM) and next is background subtraction to obtain image difference. The Gaussian Mixture Model extracts and highlights only moving objects in the frame whereas Image difference is the difference of any reference frame with its consecutive frame. Next step is to perform EX-OR operation on the two obtained images. This step gives us the final difference of N^{th} and (N+50)th frame. This helps us to identify the abandoned object. The following step is to classify whether the abandoned object is a bag or not. This is done by comparing the extracted feature (regionprops) with Bag of Words. Bag of Words is a dataset where it distinguishes between bag and man. Hence we determine that the bag is successfully detected.

3.1.1 Gaussian Mixture Model (GMM)

Gaussian Mixture Model (GMM) is used for background subtraction. In this model, the intensity at each pixel is modeled as the weighted sum of multiple Gaussian probability distributions, with separate distributions representing the background and the foreground. The method used first detects blobs from the foreground using pixel variance thresholds and then calculates several features for these blobs to decrease false positives. The approach maintains two separate backgrounds- one each for long and short term durations- and modifies them using Bayesian learning. These are then compared with each frame to estimate dual foregrounds.

A Gaussian mixture model is parameterized by two types of values, the mixture component weights and the component means and variances / covariances. For a Gaussian mixture model with K components, the k^{th} component has a mean of μ_k and variance of σ_k for the univariate case and a mean of μ_k and covariance matrix of Σ_k for the multivariate case. The mixture component weights are defined as $ø_k$ for component C_k, with the constraint that $\sum_{i=1}^{K} \emptyset_k = 1$ so that the total probability distribution normalizes to 1. If the component weights aren't learned, they can be viewed as an a-priori distribution over components such that p (generated by component C_k) = $ø_k$. If they are instead learned, they are the a-posteriori estimates of the component probabilities given the data.

For a Two-Dimensional model:

$$p(\bar{x}) = \sum_{i=1}^{K} \phi_k \, N(\bar{x} \mid \bar{\mu}_i, \Sigma_i)$$

$$N(\bar{x} \mid \bar{\mu}_i, \Sigma_i) = \frac{1}{\sqrt{(2\pi)^K |\Sigma i|}} \exp\left(-\frac{1}{2} (\bar{x} - \bar{\mu} i)^T \Sigma i^{-1} (\bar{x} - \bar{\mu} i)\right)$$

$$\sum_{i=1}^{K} \phi_i = 1$$

3.1.1.1 K-means Clustering

Simulated data in the plane is clustered into three classes which is represented by yellow, blue and green in Fig. 3.1 by the K-means clustering algorithm.

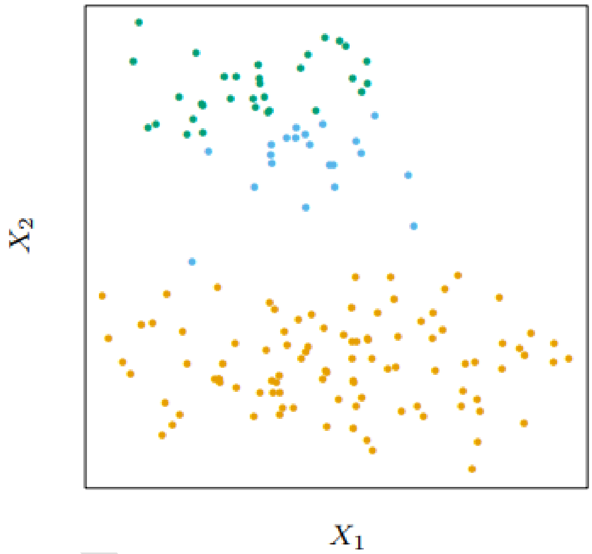

Fig 3.1: K- means clustering

K-means Clustering Algorithm:

In the first step, for each data point, the closest cluster center (in Euclidean distance) is identified. Secondly each cluster center is replaced by the coordinate-wise average of all data points that are closest to it. These two steps are alternated until convergence. This algorithm converges to a local minimum of the within-cluster sum of squares. Typically multiple runs from random starting guesses are used, and then the solution with lowest within cluster sum of squares is chosen.

3.1.1.2 Vector Quantization

Vector Quantization is the process of converting blocks of an image into vectors using k-means clustering. This is done by dividing a large set of points into groups having approximately the same number of points closest to them. Each group is represented by its centroid point, like in k-means and some other clustering algorithms. Vector quantization is used for image compression.

3.1.2 Bag of Features

A Bag of Features method is one that represents images as orderless collections of local features. The name comes from the Bag of Words representation used in textual information retrieval. This section provides an explanation of the Bag of Features image representation, focusing on the high-level process independent of the application.

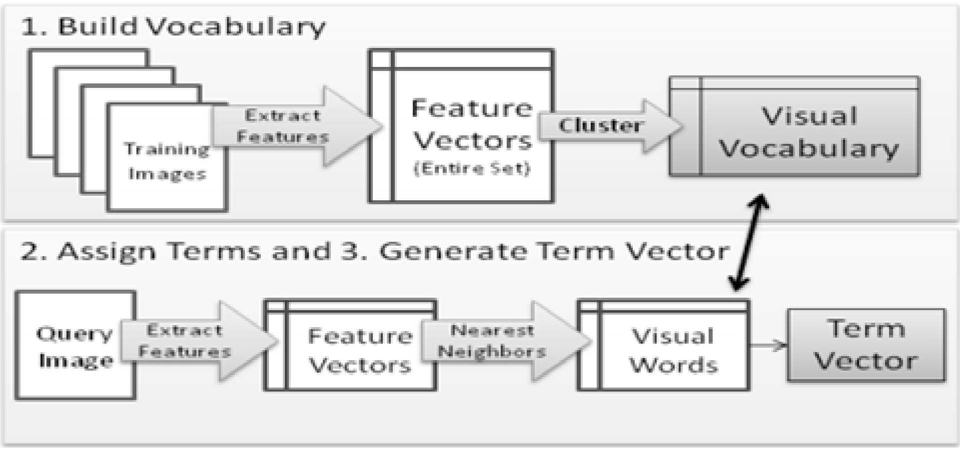

Fig 3.2: Process for Bag of Features

Given N training images belonging to M classes, an interest point detector is employed to detect representative interest points. As basic elements of object representation, image patches around detected points are extracted and normalized to uniform scale. Then SIFT descriptor is used to represent features of these local regions. However, sliding window, regular grid and random sampling as well as other feature descriptors can also be applied to obtain patches. Given a collection of image patches, codebook is formed by performing K-means clustering algorithm. K is the size of codebook. Codewords are then defined as the centers of clusters. Thus descriptors in each training image can be coded by hard assignment to the nearest codeword, yielding a histogram $n(w_i, d_j)$ counting the frequency of occurrence of each codeword, where w_i denotes i^{th} visual word in the K-size codebook and d_j is j^{th} class. The histogram is treated as a 'bag'. After representing a test image as a histogram, the most similar training histogram can be found by some similarity metric and corresponding object class label is also returned.

3.1.3 Surf feature

S.U.R.F or Speeded Up Robust Features is a patented algorithm used mostly in computer vision tasks and tied to object detection purposes. SURF uses square-shaped filters as an approximation of Gaussian smoothing. Filtering the image with a square is much faster if the integral image is used:

$$S\,(x, y) = \sum_{i=0}^{x} \sum_{j=0}^{y} I(i, j)$$

The sum of original image within a rectangle can be evaluated quickly using the integral image, requiring evaluations at the rectangle's four corners.

SURF falls in the category of feature descriptors by extracting keypoints from different regions of a given image and thus is very useful in finding similarity between images:

The algorithm works as follows:-

1. Find features/keypoints that are likely to be found in different images of the same object. Those features should be scale and rotation invariant if possible. corners, blobs etc are good and most often searched in multiple scales.
2. Find the right "orientation" of that point so that if the image is rotated according to that orientation, both images are aligned in regard to that single keypoint.
3. Computation of a descriptor that has information of how the neighborhood of the keypoint looks like (after orientation) in the right scale.

SURF is advertised to perform faster compared to previously proposed schemes like SIFT. This is achieved by:

1. Relying on integral images for image convolutions.
2. Building on the strengths of the leading existing detectors and descriptors (using a Hessian matrix-based measure for the detector, and a distribution-based descriptor).
3. Simplifying these methods to the essential

3.1.4 Classifier : SVM - Support Vector Machine

Support Vector Machine (SVM) is a supervised binary classification algorithm. Given a set of points of two types in N*N dimensional place SVM generates a (N−1)(N−1)dimensional hyperplane to separate those points into two groups.

Consider there are some points of two types in a paper which are linearly separable. SVM will find a straight line which separates those points into two types and situated as far as possible from all those points. In Fig. 3.3, straight line AA and BB, both are separating two types of point correctly but AA is situated as far as possible from all those points. SVM will elect AA as the separating hyperplane. In this image, a light blue area around line AA and BB can be seen. This is called Margin. It is defined as the distance from the hyperplane to the nearest point, multiplied by 22. In another way, hyperplane will stay in the middle of the margin. Highest margin will give the optimal hyperplane.

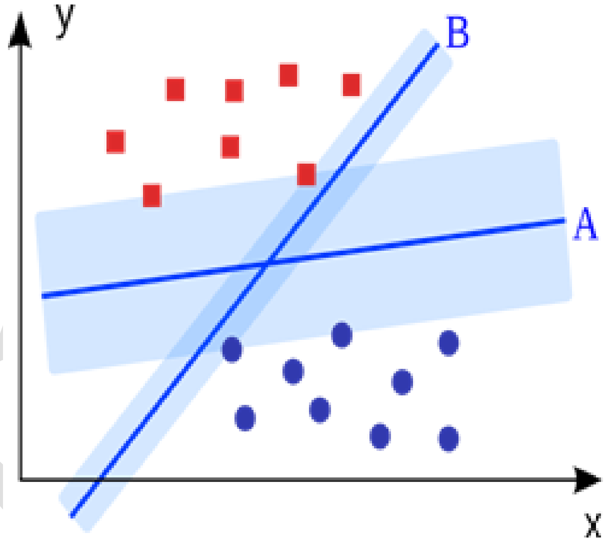

Fig 3.3: Explanation for SVM

Chapter 4

Simulation and Experimental Results

This chapter is dedicated to a discussion of the results obtained for our project. We implemented the code for obtaining the result of object detection in MATLAB R2018 software.

4.1 Simulation Results :

We have considered two videos for testing purpose and found the results for the same. Video1 is a video taken from a dataset and Video2 is a video which was shot by us in our college premises for the purpose of testing.

For Video1, after preparing a dataset and training the system, the bag was successfully detected. The bag is enclosed in a green box in the Fig. 4.1. We observe that the blob obtained was exactly encompassing the bag. Similarly for Video2, which was a crowded scenario, the bag was successfully detected. The bag is enclosed in a green box in the Fig. 4.2. But the position of the blob was partially on the bag and not entirely around the bag, hence we do not obtain maximum accuracy for this video.

Fig 4.1: Output for Video1

Fig 4.2: Output for Video2

4.2 Observations:

TABLE 4.1: PERFORMANCE PARAMETERS OF TWO VIDEOS

VIDEO	ACCURACY (%)	POSITION OF BLOB
VIDEO1	100	Accurately on the bag
VIDEO2	80	Partially on the bag

Chapter 5

Conclusion

5.1 Conclusion

Our project introduces a general framework to detect an unattended bag from a CCTV footage. The proposed algorithm is appealing in its simplicity and intuitiveness, and is demonstrated experimentally to be conceptually sound. Our method needs 0.15s averagely for each frame (nearly 7 frames a second) with a 2.4 GHz CPU in Win10. Our method successively solved the problem of person’s “came in, and left” in a video sequence, which is quite common in public sceneries. By making use of the Gaussian Mixture Model, we could eliminate the background within less time and extract more accurate foreground. However, we should also notice that it could not cope with the situation that objects in background from the start are later moved away, which will cause a ghost subsequently. When dealing with fast moving objects, such as moving cars, this undertaken method should be replaced by a method should be replaced by a speed insensitive method. The implication of the MoG method is to satisfy real-time application also needs to be considered.

5.2 Future Scope

In the future, a robot can be created which will go to the location of the unattended bags/ goods to scan it for malicious content. Also laser scanners can be used for scanning the bags/goods. We can also store the face of the person in a local database, who was first associated with the bag.

References

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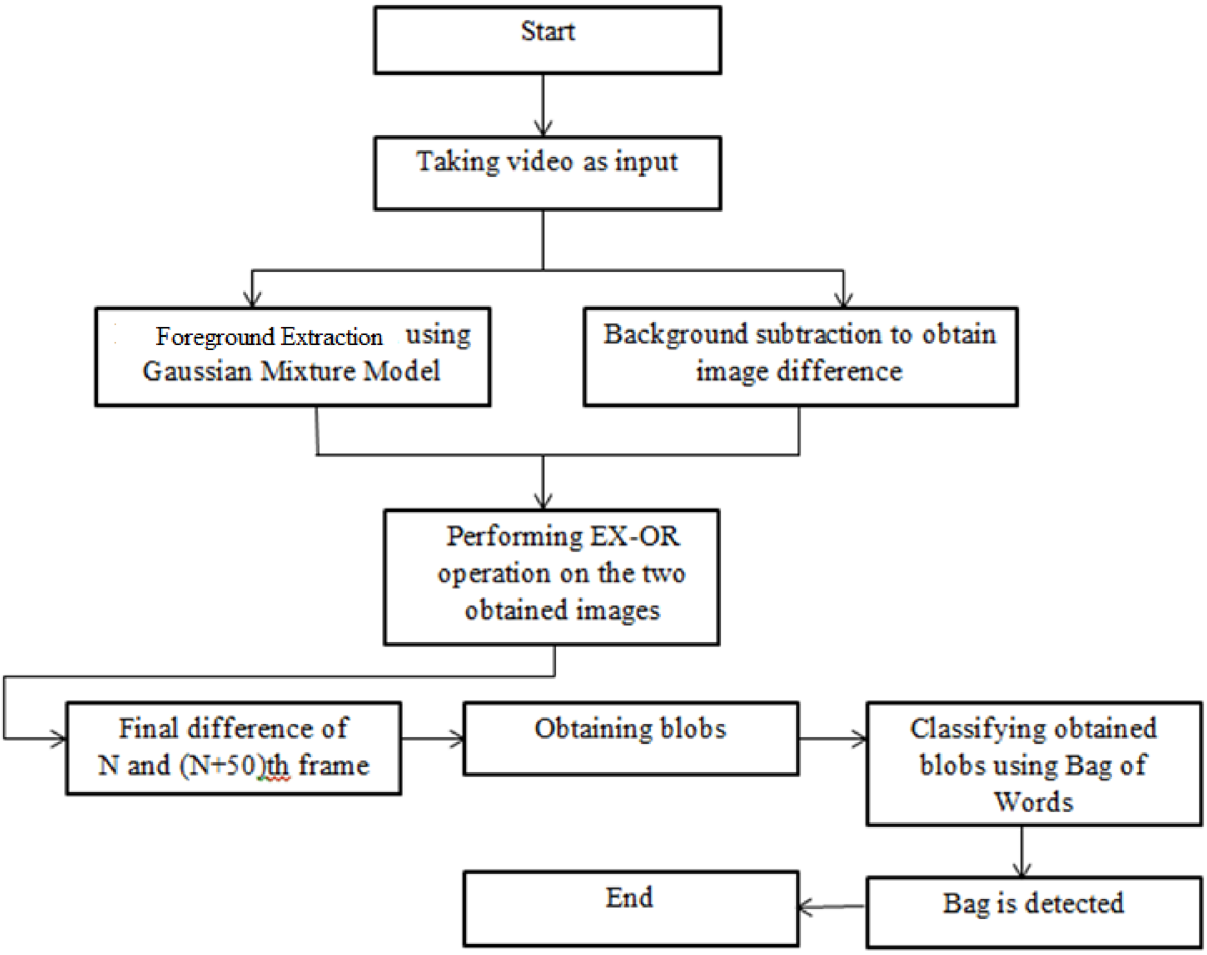
[8] Dataset on Object Detection - Retrieved from http://imp.iis.sinica.edu.tw/ABODA/

Appendix A

Flow chart of the Project



Code

REGIONPROPS:

```
clc;
close all;

foregrounddetector = vision.ForegroundDetector('NumGaussians', 2,'NumTrainingFrames', 50);
videoFReader = vision.VideoFileReader('C:\Users\madal\OneDrive\Desktop\video1.avi');
videoPlayer = vision.VideoPlayer;
count=1;
Flag1 = 1;
Flag2 =0;
while(~isDone(videoFReader))  %
        frame = rgb2gray(step(videoFReader));
if(Flag1==1)
    frame_org = frame;
    Flag1 = 0;
End

foreground = step(foregrounddetector);
%figure(1), imshow(foreground);
frame_diff2 = frame_diff>0.01;
frame_diff = imdilate(frame_diff,strel('disk',5));
frame_diff2 = imfill(frame_diff2,'holes');

%videoPlayer.step([filteredForeground,frame_diff2]);
%figure(3),imshow(filteredForeground);  %clean foreground
%figure(3),imshow(frame_diff2);  %bag detected

clear_bcknd=or(filteredForeground,frame);

%videoPlayer.step([filteredForeground,frame_diff2,frame]);

    if (Flag2==0)
        ref=clear_bcknd;
       Flag2=1;
    end
        refnew=clear_bcknd;
       count=count+2;

    if count>5
         op=xor(ref,refnew);
         stats=regionprops(op);

         count=0;
         ref=refnew;
```

```
for kk=1:size(stats,1)
       bbox=stats(kk).BoundingBox;
       area=stats(kk).Area;

     img2=imcrop(frame,bbox);

        result= insertShape(frame, 'Rectangle', bbox, 'Color', 'green');
        ppl=size(bbox, 1);
       result=insertText(result, [10 10], ppl, 'BoxOpacity', 1,'FontSize', 14);
     figure(4);imshow(result); %detected box
```

ALARM:

```
N=10000;
s=zeros(N,1);
for a=1:N
s(a)=tan(a); %*sin(-a/10);
  end
Fs=2000; %increase value to speed up the sound, decrease to slow it down
soundsc(s,Fs)
sound(s)
end
end
end
end
```

TRAINING OF DATASET:

```
clc;
close all;
imds=imageDatastore('C:\Users\madal\OneDrive\Desktop\dataset1\Train',
'LabelSource','foldernames','includesubfolders',true);
imds2=imageDatastore('C:\Users\madal\OneDrive\Desktop\dataset1\Test',
'LabelSource','foldernames','includesubfolders',true);
categoryClassifier = trainImageCategoryClassifier(imds,bag);
confMatrix = evaluate(categoryClassifier);
```

Appendix B

TIMELINE CHART FOR SEMESTER VII																	
MONTH	JULY				AUGUST					SEPTEMBER				OCTOBER			
WEEK NO.	W1	W2	W3	W4	W1	W2	W3	W4	W5	W1	W2	W3	W4	W1	W2	W3	W4
WORK TASKS																	
1.PROBLEM DEFINITION																	
Search for topics & understood the goal			■														
Learnt to extract frames from a video				■													
2.PREPARATION																	
Implemented edge detection method					■												
Implemented foreground subtraction methods						■	■										
Implemented template matching method								■	■								
Study of related IEEE papers and books								■	■								
3.PLANNING																	
Researched about Blob matching techniques & finally chose Viola-Jones algorithm										■	■						
Studied about Viola-Jones algorithm												■	■				
4.EXECUTION OF THE PROJECT																	
Simulation for face detection														■	■		

TIMELINE CHART FOR SEMESTER VIII																
MONTH	JANUARY				FEBRUARY				MARCH				APRIL			
WEEK NO.	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4	W1	W2	W3	W4
WORK TASK																
1. CONTINUATION OF PROJECT																
Association of man with bag on MATLAB																
Rejection of current method and started exploring new methods																
2. EXPLORED NEW METHODS																
Researched a new method - Gaussian Mixture Model																
Extracted frames from Video and selected only moving objects for Foreground extraction																
Trained the dataset for Testing Models																
3. EXECUTION OF THE PROJECT																
Model training and testing for Video1																
Model training and testing for Video2																
Final Testing and simulation on MATLAB																
Performance Parameter																
4.BLACKBOOK & DOCUMENTATION																
Black Book																
Presentation & Documentation																

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Alston D’Almeida

Aishwarya Gupta

Gayatri Das

Arindam Ghoshal