Abandoned Object Detection And Vigilance Enhancement Using Video Surveillance

Kavita Patel, Prof. G. Ramya

***Abstract*— In densely populated developing countries like India, there exists a threat on social security and solace, due to notorious extremists and miscreants. On various occasions such as Mumbai Serial Blasts 1993, 11 Sep 2001 Suicide attacks against United State. Insurgent terrorism incident with Taj Hotel on 26 November 2008 Mumbai, and several others, abandoned objects were used to threaten the sovereignty and communal harmony in India. Several human casualties are caused due to such incidents, along with damages done to public/private properties, causing financial losses as well as emotional trauma. In our research we tried to put forward a solution using public surveillance cameras to detect abandoned objects, and trigger necessary alarm to authority and vigilance. Proposed algorithm is based on frame by frame image segmentation and fusing several frames within the critical time window, the algorithm is intelligent enough to take care of angular alignment, and multiple movements. The project was tested on real time video capture, the results were found to raise very low false alarms and scarcely missed detections using video stream captured.**

***Keyword*: Abandoned object detection, Video Surveillance, Background Subtraction, Blob analysis, Morphological operation.**

I. INTRODUCTION

Recent terrorist attacks have highlighted the importance of video surveillance system at public places like Airports, Railway Stations. In last twenty years, visual surveillance system has attracted more researchers to develop an efficient abandoned object detection system because of its vital application prospects and due to security concern. In most of the current setups, the recorded video has to be examined to reconstruct an event whenever an alarm is generated. Therefore there is a need to develop a smart surveillance system which will be automatically detecting dangerous situations. Researchers are working towards the video surveillance systems to make it more efficient, by developing fast, reliable and robust techniques and algorithms for moving object detection, classification, tracking and activity analysis.

To provide people a safe environment when travelling with public transportation, it is necessary to provide better security systems at transportations area. Security cameras are installed at such places to recognize suspicious activity automatically. Even though security guards are monitoring the security videos, activity of people, they are not always able to detect and recognize all the crime due to their limited ability. With the help of software crime and suspicious activity can be automatically detected, the guard will be warned and he can watch at the videos and generate an alarm if necessary.

1.1 Introduction to Abandoned Object Detection

Abandoned object detection (AOD) is the task of identifying, recognizing and locating objects that are left in a scene. Often these objects are static, quite small and are frequently impeded by other people or vehicles moving about the scene.

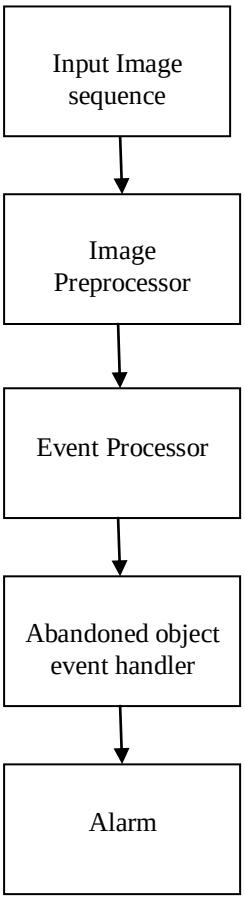

Figure 1.1: Block diagram of abandoned object detection

AOD systems are developed from foreground segmentation algorithms. Medium term motion information, pixels that

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are not part of the background image, still images are used to find regions containing suspicious objects or abandoned objects.

Abandoned Object Detection is the most challenging task in the video surveillance system due to the rise of terrorism and global security. With the rise of terrorism and global security it is very difficult to develop efficient threat detection systems that can recognize and detect potentially dangerous situations, and alert the authorities to take proper action to avoid any anti social activity. Various kinds of Anti Social Activities such as bomb attacks, theft, and other terrorist attacks have led to the need for Video Surveillance systems. Many public and crowded areas equipped with cameras at multiple angles to monitor the suspicious activity and security of that area to provide security to citizen. The surveillance systems are installed on public places to monitor and prevent terrorist attacks and other dangerous activity. There are lot of research that has being done in the field of abandoned object detection system for the video surveillance systems to provide security and automate the surveillance System with proper human controlled or CCTV systems. Various kinds of algorithm and techniques are developed to enhance the effectiveness and quality of the system.

1.2 Introduction Of Blob Analysis

Blob analysis is a fundamental method of machine vision with high flexibility and excellent performance. It is a tool for object inspection and detection, blob analysis block used to calculate statistics for labeled regions in a binary image. Blob analysis is used to eliminate blobs that are of no interest based on their spatial characteristics, and keep only the relevant blobs for further analysis where computation is time consuming. It provides solution for a wide range of visual inspection problem.

Fig 1.2 Steps of Blob Analysis

A blob or binary large object is a group of connected pixel in binary image, it is defined as an area of touching pixels with the same logical state. There are two type of state in AOD (Abandoned Object Detection), Foreground and Background state. In any image all pixel that belong to a blob are in a foreground state and other pixels are in a background state. In a binary image, background pixels have values equal to zero while every nonzero pixel is part of a binary object. To detect blobs in an image we can use blob analysis and make selected measurements of those blobs.

Blob analysis consists of 3 steps:

1. Extraction

It is an initial step of image threshold method which is applied to find a region corresponding to the object being inspected. Blob extraction isolates the blob in binary image.

2. Refinement

The regions which are obtained from previous step are often flawed by various kind of noise due to lightning and poor image quality.

3. Analysis

It is the final step of blob analysis in which refined regions obtained from previous step are analyzed to produce final result. It the region represent multiple objects, it is split into individual blobs, which is inspected separately. Once we obtain the region that corresponds to the object or the objects being inspected, we may commence the analysis that is, extract the information we are interested in.

II. LITERATURE REVIEW

In recent years, much effort has been devoted to designing systems that automatically detect abandoned objects in public areas. Considerable research work has been carried out to provide techniques and algorithms to identify and provide proper alerts in security situations. But implementations of those techniques are costly because some needs special hardware and software implementation as well as proper man power with good technical knowledge. Processing of images to determine such kind of activity is not an easy task, many available commercial video surveillance systems are also associated with human inspections.

Haritaoglu et al described a method which is based on periodic motion and static symmetry. This identifies the behavior and activity of person whether he carries, left the objects which is marked as abandoned object. Systems such as employ adaptive background subtraction (ABS) techniques to detect unknown, changed, or removed objects. Spengler and Schiele propose Condensation algorithm to detect abandoned objects and tracking people and find suspicious activity.

Martinez-del-Rincon et al and Aguilera et al have explored the use of multiple cameras, in his technique he uses multiple cameras for similar surveillance tasks to capture different activity in different settings. They proposed a system that used a double background subtraction (BGS) method capable of detecting short term abandoned objects. Long term (background only) and short term (background with recently stopped objects) are identified and these models are combined with the current frame to locate static regions. These regions are fed into an accumulator, where once a fixed or predefined time is reached the object is classified as static or abandoned object. For the object to be classified as abandoned luggage or object, size and shape requirements must be met.

Tejas [2] et.al worked on the AOD for automated surveillance using Hadoop. By the use of Hadoop Horton works Data platform 2.0, he proposed a system for video surveillance system which can increase the performance and the efficiency in terms of processing speed. The system was able to classify and detect the abandoned objects and update. His proposed system provides a proper solution of occlusion associated with other traditional approach, but the experimental results were not commendable to prove that the system overcomes occlusion and hence it continues to be a hindrance to the efficiency.

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Denman [12] et.al proposed Abandoned Object Detection which is based on the multi-layer motion detection. This algorithm uses a variable threshold and deals with lighting changes, and properly works with varied contrast levels of light changes across the scene. In multi-layer motion detection algorithm foreground segmentation allows occlusions to be handled partially. He proposed a motion detection system that is capable of detecting medium term motion as well as regular motion. Multiple layers of medium term motion can be detected and segmented. Multiple motion detectors are used to perform abandoned object detection, by detecting multiple layers of motion, and allowing overlaps when lower layers are occluded, occlusions can be handled effectively. It handled occlusion effectively and eliminated the need of multiple motion detectors.

Huiyuan Fu, Mei Xiang, Huadong Ma, Anlong Ming and Liang Liu [10] this paper focused on the important problem of detecting the static abandoned objects from the vehicles in the highway scenes. They propose a new three-stage static object detection framework. In this paper, they present a new framework to detect the abandoned objects. In their framework, to model the background GMM (Gaussian mixture model) is used, but it is not possible to updated every frame for keeping the abandoned objects in the foreground. To erase the Noise caused by sunshine or wind are erased by an edge statistics feature. In their model object tracking module is also integrated into the framework for better abandoned object detection.

Author	Year	Method/Technique	Remarks
Haritaoglu	1999	adaptive background subtraction (ABS)	Determine if the person is carrying an object to detect unknown, changed, or removed objects.
Spengler and Schiele	2003	Condensation algorithm	Detecting abandoned objects and tracking people.
Martinez-del-Rincon	2006	Surveillance tasks in different settings	Detecting abandoned objects and tracking people.
Denman	2007	Modified PLGP	Protocol independent attacker model.
Huiyuan Fu, Mei Xiang, Huadong Ma, Anlong Ming and Liang Liu	2011	Gaussian mixture model (GMM)	Detecting the static abandoned objects from the vehicles in the highway scenes.
Jiyan Pan, Quanfu Fan, Sharath Pankanti	2011	Region-level analysis in both background maintenance and static foreground object detection.	Robust abandoned object detection algorithm for real-time video surveillance.
Chathuranga Hettiarachchi, Asitha Nanayakkara, Ayesha Dissanayaka, Charith Wijenayake, Chathura De Silva	2014	Implemented using a simple logical reasoning upon textual data.	abandoned object detection tool based on a set of possible events and on a set of rules to act upon those events

Table 2.1 Abandoned Object Detection Techniques

Jiyan Pan, Quanfu Fan, Sharath Pankanti [9] Propose a robust object detection algorithm for real-time video surveillance. Their algorithm different from conventional approaches that rely on pixel-level processing, region-level analysis is used for background maintenance and static foreground object detection. For background maintenance, region-level information is used to control the learning rate. And for static foreground object detection, double-checks of region-level analysis are used for the validity of abandoned blobs. Attributed to such analysis, their algorithm is robust against illumination change, shadow and ghost left by removed objects.

Chathuranga Hettiarachchi, Asitha Nanayakkara, Ayesha Dissanayaka, Charith Wijenayake, Chathura De Silva [1] introduces an abandoned object detection tool based on logical reasoning. In their algorithm a set of possible events and a set of rules to act upon those events are used to detect suspicious activity. This implementation is simple, robust and reusable and more efficient than existing techniques. Their implementation is based on simple logical reasoning technique upon textual data, in order to image centric processing. Foreign objects which are marked as abandoned objects are extracted using background subtraction model. Results of blob detection are passed to an abandoned object detector system in a textual format to capture suspicious activity. Acyclic graph of asynchronously interconnected lightweight processing modules or an abandoned object detector evaluates the variations of speeds and inter-blob distances. By configuring several parameters, it generates an alarm or alert to encountering security threat.

During the last decade, due to severe terrorist attacks extensive work has been going on the automation of CCTV surveillance installed on the airports and railway platforms. Researchers are continuously working to provide fully automated real time AOD systems. This section will focus on the review of some important literature present.

III. IMPLEMENTATION

The proposed system has four main modules:

1. Region of interest
2. Video segmentation
3. Background Subtraction
4. Morphological Operation
5. Object Tracking
6. Activity recognition

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Figure 3.1 shows the proposed algorithm, first Region of interest is selected, then video is segmented into frames, shots or images for processing background subtraction is performed to detect any new object that may have entered the scene. After that the determination or extraction of foreground image objects are tracked by blob analysis. The final module i.e activity recognition that differentiates between removed and abandoned objects. After the activity recognition an alarm is generated when abandoned objects are detected.

3.1 Region Of Interest

Region of interest or Roi is defined as maximum number of objects to be track. Region of interest roi differs from one environment to another environment. For a particular purpose Region of interest is a selected as a subset of given dataset, the region of number of objects to be track. In this proposed system ,the first frame which is captured from camera is taken as the sample to detect the region of interest. The first frame detected is considered as a background subsystem from which individual static objects are detected and stored in the subsystem as region of interest. So region of interest follows two different phases. First, the system will detect the region of interest from the background system and then store it in a separate subsystem.

3.2 Video Segmentation

Videos can be segmented such as scenes, images, shots and frames at different levels. Video Segmentation involves modulating the surveillance video for easy processing of video at various levels. In common, Frame is the least of segmentation possible, where each frame contains only the static objects. In this proposed system frames are taken into consideration for detecting the objects and shots for object detection. First the video is segmented into various forms of scenes, shots and frames. Here the video is modulated as shots. Shots are the set of frames independent of each other. Shot boundaries are detected by comparing the frames that are independent of each other.

3.3 Morphological Operations

Morphological image processing is a collection of non-linear operations related to the shape or morphology of features in an image, morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological closing is performed to fill in small gaps in the detected objects.

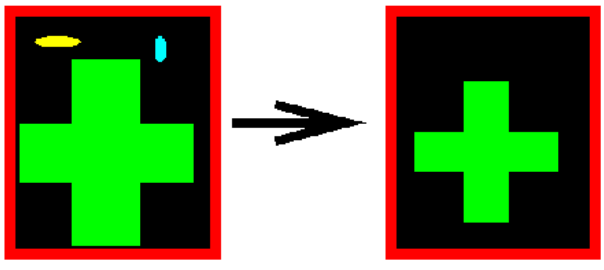

Fig. 3.1 Morphology

Closing - structured filling in of image region boundary pixels, the closing of A by B is obtained by the dilation of A by B, followed by erosion of the resulting structure by B:

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

Perform Morphological Close operation to fill in small gaps in the detected objects.

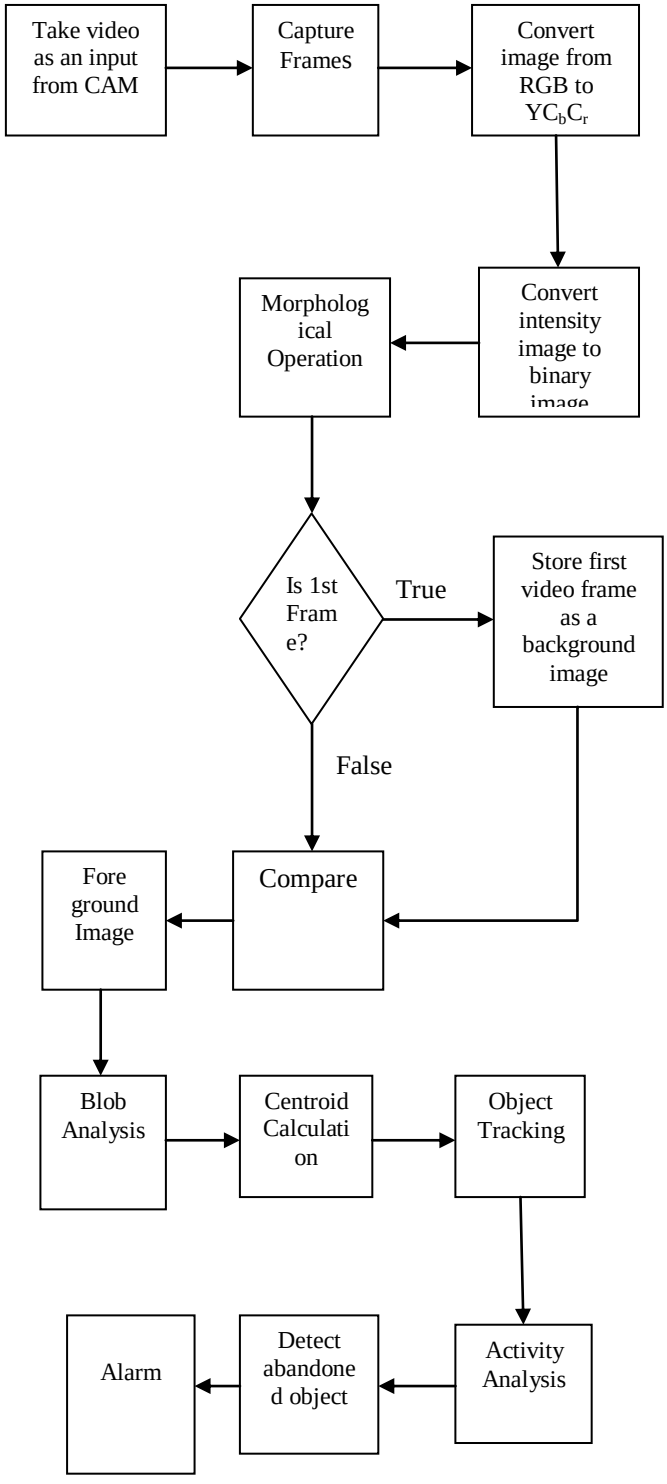

Fig 3.2: The Block Diagram of Proposed System

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3.4 Object Tracking

The objective of object tracking is to construct a correspondence between objects in consecutive frames. Detection of objects for tracking in frame by frame is a significant and difficult problem. It is a crucial part for video surveillance system since without tracking the object,

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the system could not extract the information about objects and further higher level event analysis steps would be difficult. On the other hand, inaccurate segmentation of foreground objects due to occlusions, shadow and reflectance makes tracking a difficult and active research problem. In this step object is tracked through blob analysis.

3.5 Activity Recognition

After successfully tracking the moving objects from one frame to another in a video, the problem of recognizing an event from scene follows naturally. Activity recognition involves action recognition and description. Activity recognition can guide the development of object motion analysis systems. It is the most important area of future research in motion analysis.

IV. RESULT

In this project work Abandoned object detection system it takes image captured from camera as an input, track and recognize results and fuses these into object estimation. With the image segmentation all objects in video can be detected whether they are moving or not by using segmentation results of successive frames. Consequently, the algorithm can be applied to multiple movements. The algorithm was tested on real time video surveillance system and it produces very low false alarms and missing detection.

Parameter	Value	Usage in detection
Threshold factor	1.3	Still object
Persistence factor	0.7	Relative movement
Min_blob	100	Minimum blob size
Max_blob	2500	Maximum blob size
Time frame	45	Critical window
VGA resolution	30	Frames/seconds

Table 4.1 Parameters and their values used (values are in pixels or pixels per frame respectively)

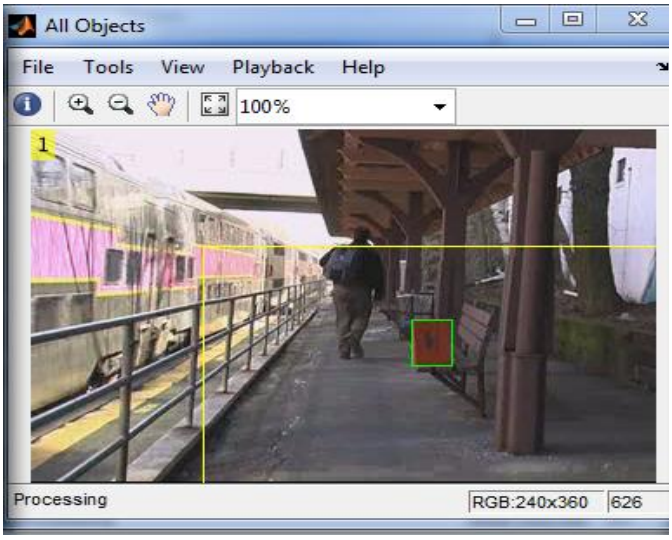

Figure 4.1(a) All object frame window, a person left an object at the scene.

In figure 4.1(a) and 4.1(b) shows the normal activity, No object is marked as abandoned. When a person left an object in scene and it is unattended for a predefined time it is marked as an abandoned.

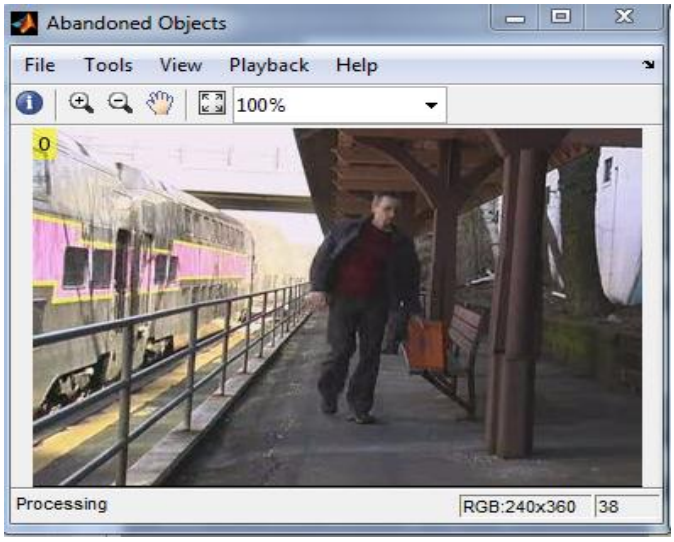

Figure 4.1(b) Abandoned object frame window, a person left an object at the scene.

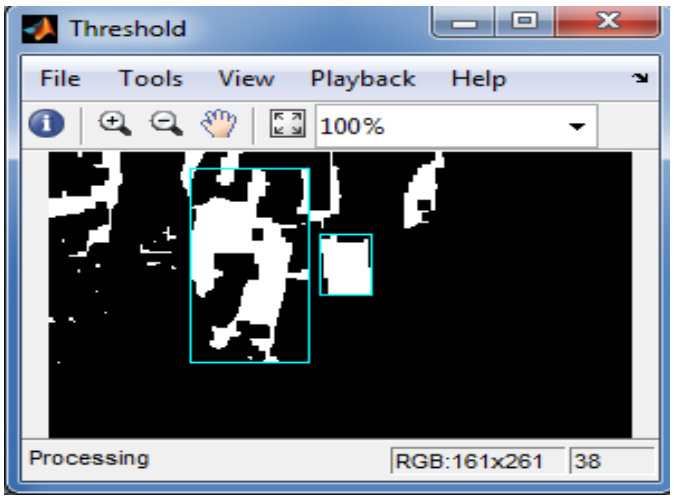

Figure 4.1(c) Threshold window.

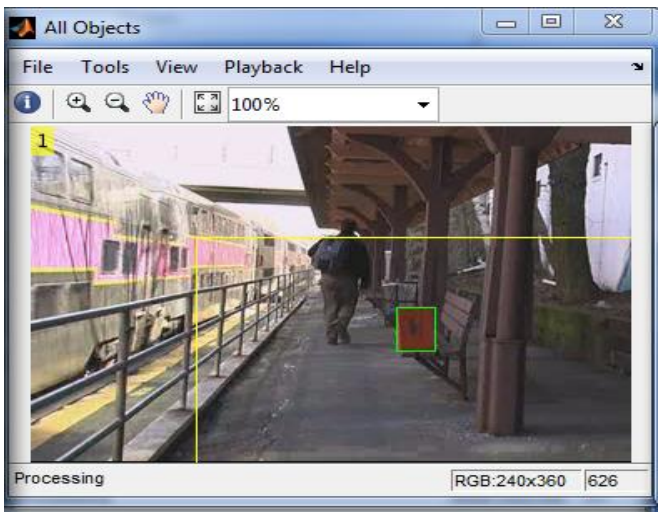

Figure 4.2(a) All object frame window

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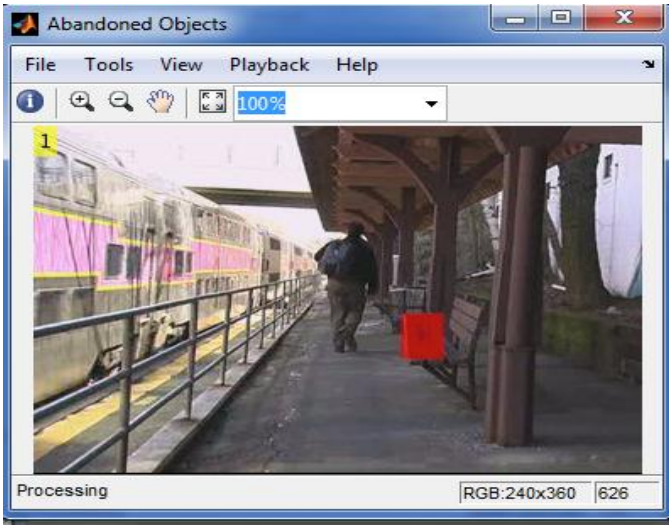

Figure 4.2(b) Abandoned object frame window, an object is marked as abandoned object.

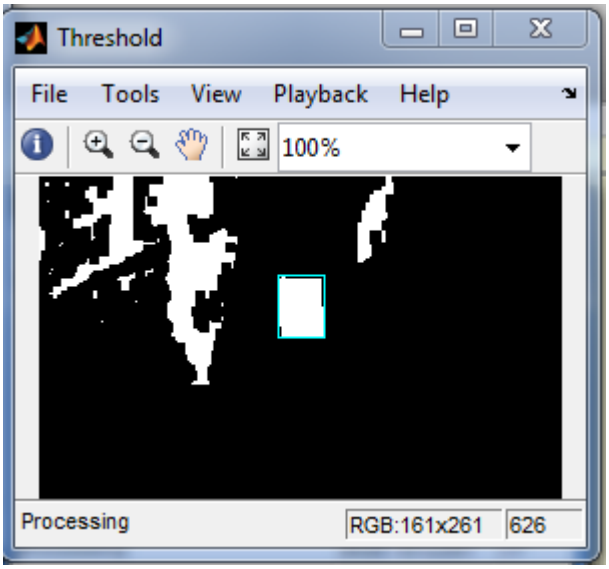

Figure 4.2(c) Abandoned object frame window, an object is marked as abandoned object.

V. CONCLUSION

Most of the existing algorithm and techniques are based on motion detection[12], aiming to detect static objects, achieved by background subtraction, followed by various kind of tracking. Some techniques are based on image segmentation, logical reasoning[1], Hadoop[2]. Commonly background subtraction is used for the segmentation of foreground regions from video sequences captured by static camera, which basically consists on detecting the moving objects from the difference between the current frame and a background model which is stored at database. To achieve good segmentation results, the background model must be regularly monitored and updated so as it can easily adapt to the varying lighting conditions and stationary changes in the scene..

Abandoned object detection (AOD) systems are required to efficiently run in high traffic situations where the probability of occlusion is high. Often stream of data from video are not pertained to be independent at any stage, so it becomes difficult to capture the video sequence into frames independent of each other. Even though frame boundary is efficient, it is always not possible to completely remove the dependency between the frames, so due to this it may lead to any miss predictions. So there is a need for proposing a new algorithm for identifying the static object as abandoned.

Our proposed algorithm provides a good solution which improve the efficiency of existing technique as well as solve the problem of occlusion and false alarm. We use blob analysis and morphological operation to track maximum number of abandoned object as possible.

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