IJIREEICE

ISSN (Online) 2321-2004
ISSN (Print) 2321- 5526

International Journal of Innovative Research in
Electrical, Electronics, Instrumentation and Control Engineering
ISO 3297:2007 Certified
Vol. 6, Issue 7, July 2018

Surveillance System for Abandoned Object Detection

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Abstract: Today security in the public places is the main concern issue faced by world. Visual surveillance is used to analyze object behavior. This paper presents an approach for abandoned object detection in security surveillance videos using raspberry pi, a single board computer and python is used as programming environment. It involves static object, moving object detection and video tracking to identify the events occurring in the scenes. The proposed system takes video input, processes video with adaptive background modelling, morphological operation is performed to find the abandoned object and motion of owner of object. A warning is initiated on the screen when abandoned object is detected. Experiments are performed on PETS 2006 and ABODA dataset.

Keywords: Surveillance, Raspberry Pi, Python, Adaptive Background Modelling, Abandoned Object

I. INTRODUCTION

According to research in visual surveillance detection of abandoned object is referred to as problem of left luggage, box or any other suspicious items. An abandoned object is defined to be a stationary object that has not been in the scene before [6]. It is important to identify the suspicious stationary object for the purpose of public security. As there is no category object type that has been abandoned, the methods that involve training object detector for particular objects turns to be inappropriate for the particular task. There have been a rise in terrorist attacks in recent years where terrorist mostly target the public areas such as airports, railway stations, shopping malls, Markets etc. Even though the video surveillance systems have been used from past few decades but the human operator or security guard becomes inefficient as they have to monitor multiple number of camera videos at a time. So the automation of surveillance system is needed. Many algorithms have been developed to tackle the problem of abandoned object detection. Most of the algorithms have failed to work satisfactorily as they involve complex probabilistic mathematics as well as the detection of abandoned object under occlusion increases complexity. This abandoned object detection algorithms involves object detection, object extraction, and object recognition. This paper discusses abandoned object detection related work in section II, The proposed system block diagram and system flow given in section III. Results are given in section IV. Finally the work is concluded in section V.

II. RELATED WORK

The way of finding semantic objects like human, animals, carriage in video scenes is called object detection [4].The object detection may be static object detection or moving object detection. Current frame information is used for object detection. Abandoned Object Detection via Temporal Consistency Modelling and Back-Tracing Verification for Visual Surveillance in [1] presented an effective approach for detecting abandoned luggage in surveillance videos. They have combine short- and long-term background models to obtain the foreground objects. They introduced a framework for identifying static foreground regions based on the temporal transition of code patterns, and to determine whether the region contains abandoned objects. Robust Detection of Abandoned and Removed Objects in Complex Surveillance Videos in [6] introduced a method for robust detection of abandoned and removed objects in complex surveillance videos based on background subtraction and foreground analysis. Occlusion, lighting changes and some other factors causes difficulty in detecting abandoned objects in tracking based methods. This paper focuses on removal of shadows and Adaptation to sudden light changes. Detecting Abandoned Objects in Crowded Scenes of Surveillance Videos Using Adaptive Dual Background Model in [3] described that the most difficult task is to detect objects in the crowded scenes due to occlusion. This algorithm uses dual background model subtraction. The matching based tracking scheme is used for occlusion handling. Left luggage detection using Bayesian interface [5] used a blob tracker to track objects based on size, aspect ratio and their location. The abandoned object is detected when the moving object becomes stationary for longer duration of time. Detection of static objects for the task of video surveillance [8] takes use of double-background models to separate objects which uses fast and slow learning rates, and both are used and the

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abandoned objects are determined by using the difference between the two obtained foregrounds. An Abandoned Object Detection System Based on Dual Background and Motion Analysis[9] Exploit a counter to count the s3abandoned objects, this algorithm combines stationary foreground detection with foreground blobs tracing method by using the blob features.

III. METHODOLOGY

A. Block diagram

As shown in the Fig.1, we can see the input in the system is given to raspberry pi processor in the form of video. The system uses raspberry pi 3 model B and python is used as programming environment. The output of raspberry pi processor is given to display which is used for displaying the warning and watching the performance of algorithm. The video input to the algorithm is having .avi extension as these formats is easy to use, easy to process and require less space for storage. Here raspberry pi processor is used which is very powerful, high speed and low cost processor available today.

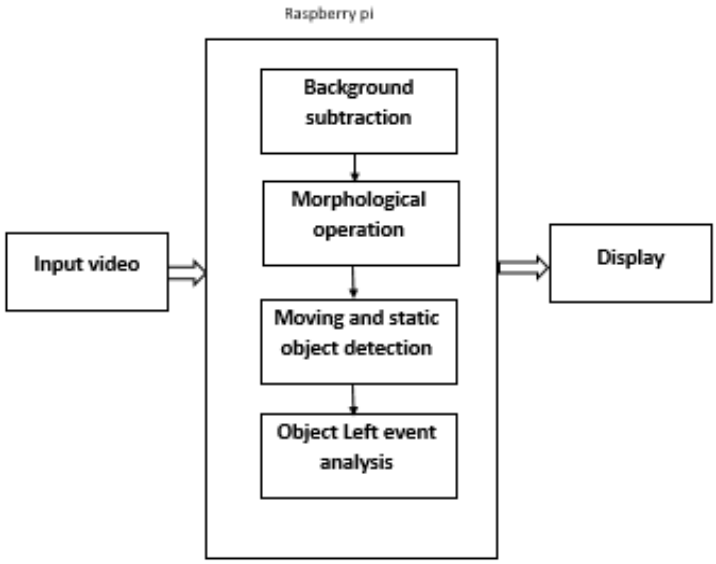

Fig.1. Block diagram of system

The algorithm executed on raspberry pi processor involves operations like background subtraction, binarization, morphological operation, left object analysis. Canny edge detection is also implemented so to identify the objects visually.

B. Operation

Fig.2. Actual set up of system

The above Fig.2 shows actual hardware setup of abandoned object detection system. The input videos with .avi format are given to algorithm. Several pre-processing tasks like defining region of interest, video to frame conversion are performed. The algorithm to separate background as well as foreground from incoming image is based on adaptive background modelling. This algorithm uses first frame of the video as reference frame. The difference between the reference fame and current frame are calculated to get the foreground. Here the pixel intensities are identified. The pixels whose intensities do not match with reference frame pixels then they are identifies as foreground pixels. The reference frame is updated robustly. So this algorithm can detect multiple abandoned objects. Now the contours are

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identified and canny edge detection is applied to improve the visual capability of objects detected for the security person. It preserves the edges while suppressing other details. Morphological operation on image frame is a collection of non-linear operation related to shape or morphological features in an image. Morphological operation is performed on greyscale image. Morphological close operation is used to enhance the frames and improve the results for further processing. Once the contours are identified next process is to track them. A set is created, detected objects are stored. If the same pixel value occurs in all frames in the list then it is detected as stationary object and not the passing object. If the detected stationary objects remains static for consecutive 100 frames then detected as abandoned object. When abandoned object is detected the 'Abandoned object' warning is initiated on the screen and the security guard gets alerted.

C. Algorithm

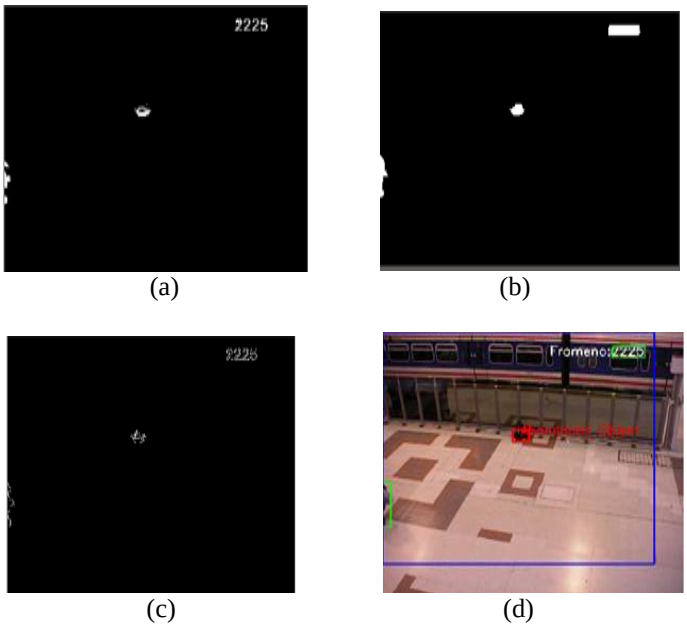
The systematic flow of operation of abandoned object detection algorithm is given below.

1. Take video as input
2. Convert video into frames
3. Adaptive Background subtraction is carried out
4. Grayscale to binary image conversion is done
5. Canny edge detection is performed
6. Morphological close operation is performed
7. Motion detection is done and objects are tracked
8. Abandoned object detection is done by checking consecutive 100frames for static object.
9. Display the warning on display "Abandoned object

IV. RESULTS AND DISCUSSIONS

This system uses raspberry pi 3 model B with 7 inches LCD display .The experiments are carried out on different videos of 2 different dataset namely PETS 2006: The data-sets are multi-sensor sequences containing left-luggage scenarios.

ABODA dataset: Abandoned Objects Dataset (ABODA) is a new public dataset for abandoned object detection. ABODA comprises 11 sequences labeled with various real-application scenarios that are challenging for abandoned-object detection. The situations include crowded scenes, marked changes in lighting condition, night-time detection, as well as indoor and outdoor environments.



(a) (b)

(c) (d)

Fig.3. Results for PETS 2006 video (a)Binarization (b)Morphological opeartion (c)canny edge detection (d)Abandoned object detection.

The Fig.3 shows the results of scene from PETS 2006 dataset.The Abandoned object is indicated by red box and warning is initiated on screen.

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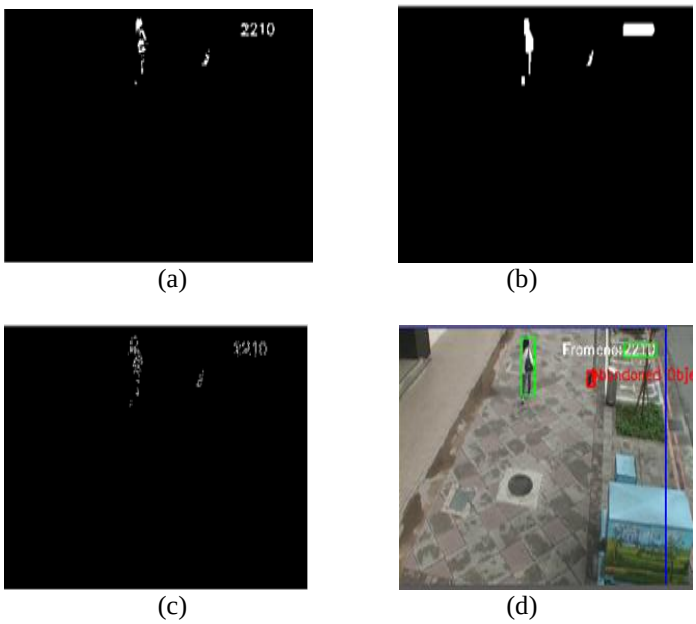

Fig.4. Results of ABODA dataset video (a)Binarization (b)Morphological opeartion (c)canny edge detection (d)Abandoned object detection.

The Fig.4 shows the results of scene from ABODA dataset.The objects detected are indicated by green box and Abandoned object is indicated by red box and warning is initiated on screen.

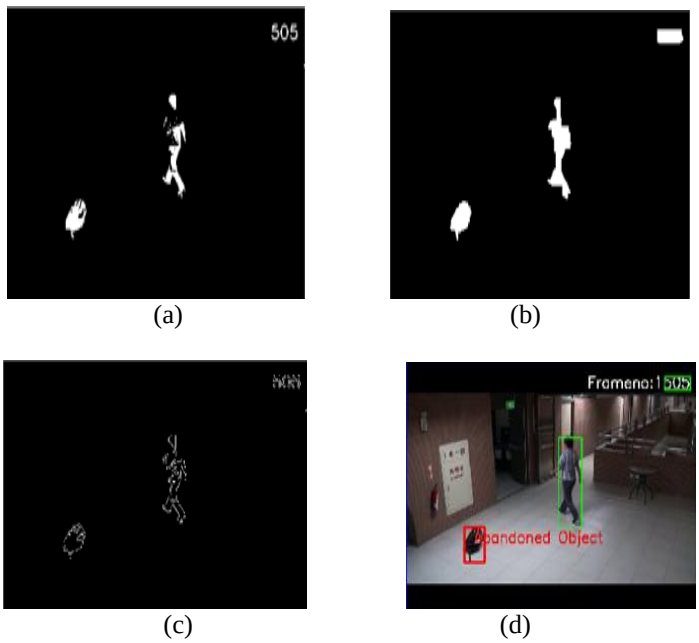

Fig.5. Results of ABODA dataset video (a)Binarization (b)Morphological opeartion (c)canny edge detection (d)Abandoned object detection.

The Fig.5 shows the results of scene from ABODA dataset.The objects detected are indicated by green box and Abandoned object is indicated by red box and warning is initiated on screen.

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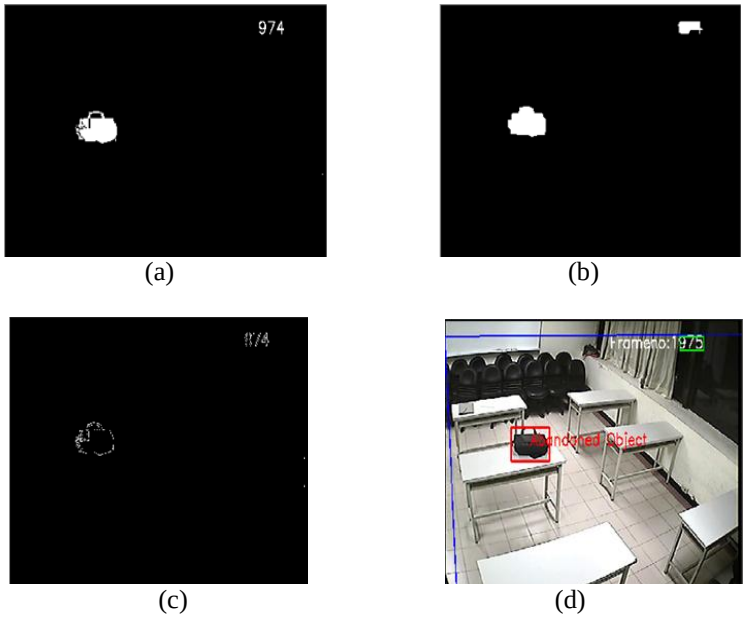

Fig.6. Results of ABODA dataset video (a)Binarization (b)Morphological opeartion (c)canny edge detection (d)Abandoned object detection

The Fig.6 shows the results of indoor scene from ABODA dataset.The Abandoned object is indicated by red box and warning is initiated on screen

V. CONCLUSION

This paper proposes effective method for abandoned object detection. This system focuses on abandoned objects detection in the public areas such as railway stations, shopping malls, airports etc. Fast and real time response to suspicious activities can be achieved. The suspicious objects like bags boxes can be easily identified using this algorithm and would be beneficial for public safety. The experimental results obtained for PETS 2006, ABODA dataset and for live videos would be same. Algorithm works efficiently for Low light changes but gives false alert for shadows.

ACKNOWLEDGMENT

The author would like to express her sincere thanks to **Prof. N. M. Wagdarikar** for his valuable references and support throughout the year. I thank him for complete support, co-operation and valuable suggestions.

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