Background Subtraction Algorithm Based Abandoned Object Detection

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Abstract— Nowadays security for public safety is becoming a challenging research topic in the field of computer vision. In this paper abandoned object detection system is implemented using raspberry pi and simulink. Detection process consists of extraction of the image from video sequence then the first image is considered as background image and subtraction algorithm is implemented for the abandoned object detection and Missing object detection. This system can be installed bus stations, train stations or airports. The proposed system gives high accuracy in real time performance.

Key words: Vehicles Counting; Traffic Light Control; Image Processing; Raspberry Pi; IoT

I. INTRODUCTION

Nowadays, there are rising antisocial activities such as bomb attack, theft, terrorist attacks so it becomes necessary to develop the video surveillance system which can detect such antisocial activities [3]. Video surveillance systems are used to monitor security sensitive areas. A video surveillance system requires algorithms for effective object detection, tracking, classification and activity analysis [1].In abandoned object detection stationary items are captured [2]. An abandoned object is the object which is left at some place which is under the video surveillance and which remains unattended for certain period of time. Abandoned object detection is very important in places such as railway stations, shopping malls, buildings entrances, sporting events, and airports and other Public venues which are the highly secured areas [3], [4]. Abandoned object detection is highly challenging task [3].

The approaches for abandoned object detection are classified into two categories first is based on object tracking and second approach is based on object detection. In crowded situations, for tracking based approach there are problems of splitting, merging, entering, leaving, occlusion, and correspondence. In detection based methods there is no need to handle the problems associated with object tracking methods [4].In object detection, first thing is to locate the object and the second thing is to classify the detected object whether it is abandoned object [5].Stationary object detection has applications in various surveillance systems such as detecting illegally parked vehicles in traffic monitoring system and detecting abandoned objects in public safety systems [5]. There are issues related to occlusions means for moving or stationary objects, appearance variations like different color composition and shape of the object as people move relatively to the camera, lighting intensity changes, also speed and density structure of moving objects should be taken into account. Video surveillance system must have capability of correctly and accurately detecting suspicious objects and people involved in crowded areas.

A. System Architecture

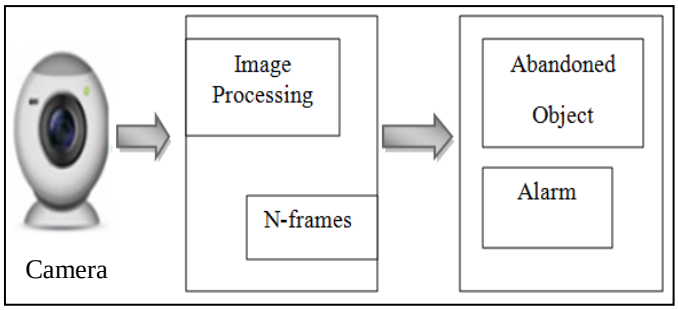

Fig. 1: System Architecture

Basic system architecture consists of camera, hardware platform and alarm system. Input is taken from camera it continuously captures video and sends video frames to hardware platform where image processing operations are performed on input frames. By applying various techniques like background subtraction technique, HSV thresholding and Gaussian blur unattended object is detected. When object is detected system will raise alarm [6].

This paper is organized as follows: Section II gives scheme of the proposed system and also explains the background detection algorithm. Section III gives the system implementation details such as hardware and software used for the implementation of the system. Results are discussed in Section IV. Finally, the work is concluded in Section VI.

II. PROPOSED WORK

A. Block Diagram of Proposed Scheme

The project consists of Raspberry-pi board along with camera, alarm driver circuit, alarm and power supply adapter. Raspberry-pi board will trigger the camera to capture a video of interest. The output of camera will then read by raspberry-pi board and further processed using image processing toolbox. From the input video, 1st frame will be captured which is without any object and stored as a background image. Again camera will be triggered and image will be captured which is having object movements. Then, background subtraction will be applied to find foreground image containing object. Noise removal is performed on background subtracted image. After, object will be classified by comparing it with stored database of objects. Classification gives the required output. Event will be detected and output to drive a buzzer/ alarm will be given by raspberry-pi board through I/O pin. If the detected event is abandoned, alarm will be ON.

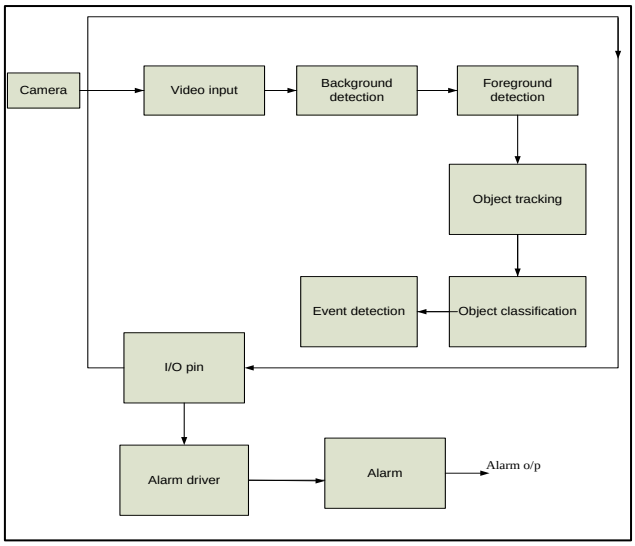

Fig. 2: Block diagram of proposed system.

B. Background Subtraction

In the area of object detection, background subtraction plays a very important role . Background subtraction (BS) is a common and widely used technique which generates a foreground mask. The origin of the background detection is to take the difference between the current image and the reference image and calculates the foreground mask. Background model consists of static part of the scene or, more in general everything that can be considered as background given the characteristics of the observed scene in general, everything that can be considered as background given the characteristics of the observed scene.

Foreground Mask= Background image – Current image

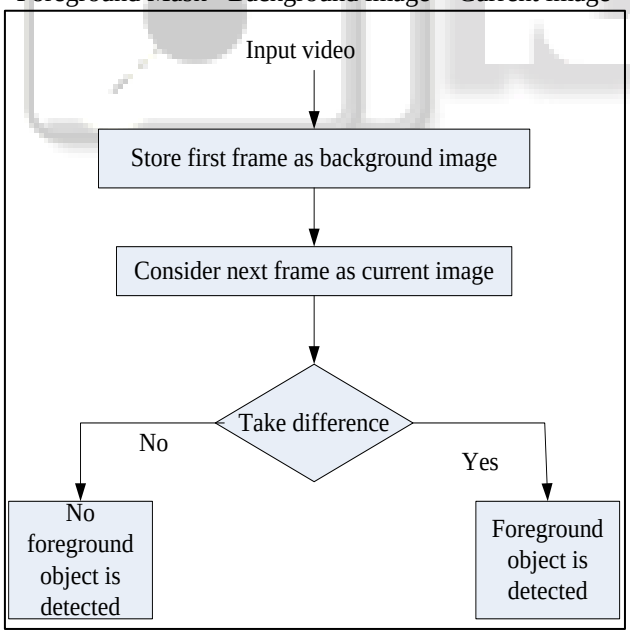

Fig. 3: Background subtraction algorithm

C. System Flow

1) Camera: Captures video sequence continuously
2) Read Image: Read Input Image
3) Store first frame as a background frame and consider next
4) frames as a current image.
5) RGB to gray conversion of image: In this step, RGB image is converted to grayscale image. Apply background subtraction algorithm.
6) Binary Image Conversion: Grayscale image is converted to binary image (black and white image).
7) Perform binary area open operation.
8) Blob Analysis: Blob analysis is performed on the binary image. Find area of the object. Convert that image into logical image in simulink.
9) Draw rectangular shapes from the points obtained in the logical image through connectivity.
10) Display detected and abandoned object in grayscale image.

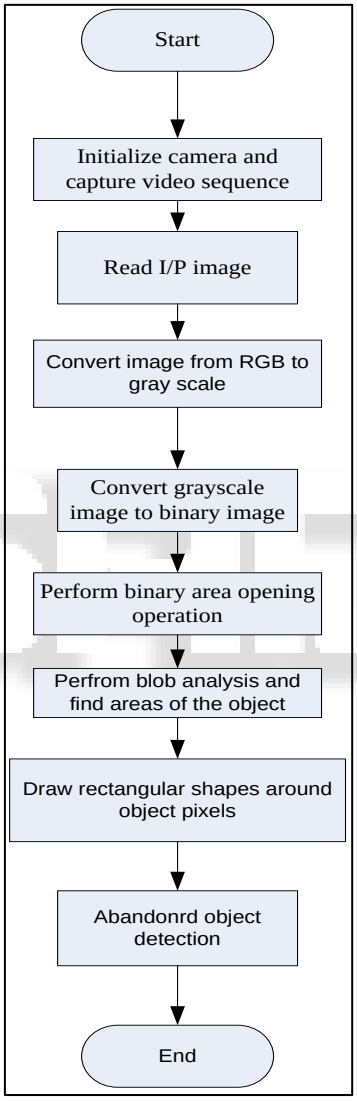

Fig. 4: System flow chart

III. SYSTEM IMPLEMENTATION

A. MATLAB

MATLAB is a high-performance language its basic data element is an array that does not require dimensioning. Matrix and vector formulations allow us to solve many technical computing problems. It integrates computation with the programming visualization which gives easy-to-use environment where problems and solutions can be expressed in the mathematical notation. Areas in which MATLAB toolboxes are available include control systems, simulation, signal processing, neural networks, wavelets, fuzzy logic,

and many others. Simulink is developed by MathWorks it is a graphical programming environment for simulating, modeling and analyzing multiple domain dynamic systems.

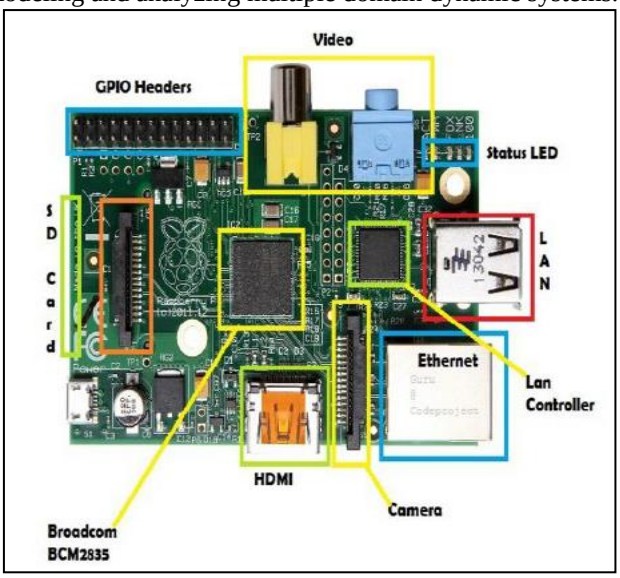

Fig. 5: Raspberry Pi kit structure

B. Raspberry Pi

Raspberry pi consists of on-chip ARM compatible central processing unit (CPU) and an on chip GPU(Graphics Processing Unit).It is based on Broadcom system on a chip (SoC), CPU speed of the raspberry pi ranges from 700 MHz to 1.2 GHz. Most boards have HDMI composite video output, a 3.5 mm audio phone jack, and one and four USB slots. It has on board memory range from 256 MB to 1 GBRAM. In raspberry pi operating system is stored in SD cards. Lower level output is provided through number of GPIO pins which support common protocols like I²C. Pi 3 and Pi Zero W have on board Bluetooth and WI-FI 802.11n.

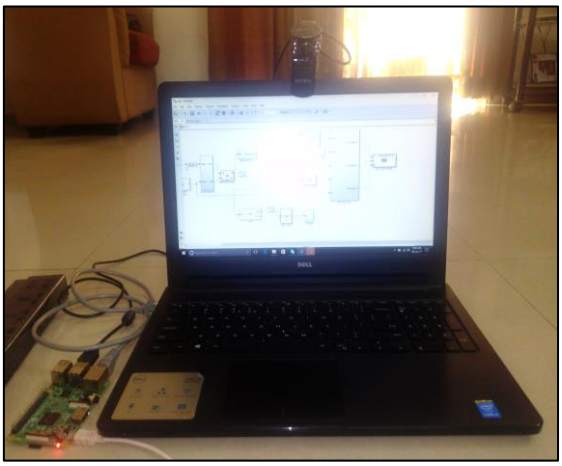

Fig. 6: Implemented Model

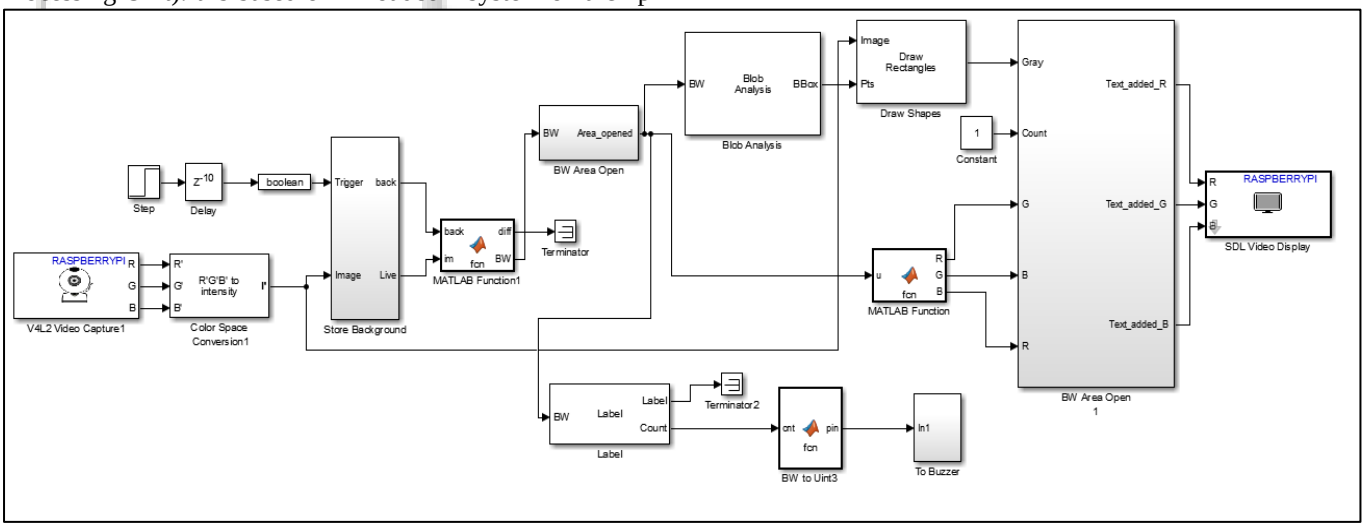

Fig.7 Simulink Model of the Proposed System Flow

IV. IMPLEMENTATION RESULTS

A. Background Subtraction Results

Results are shown in figures below. From the video sequence first frame is considered as a background image. Then background subtraction is applied between the background image and the current frame. Figure shows two background images. Abandoned objects detected and missing objects in the video are shown in figures.

Fig. 8: Background image 1

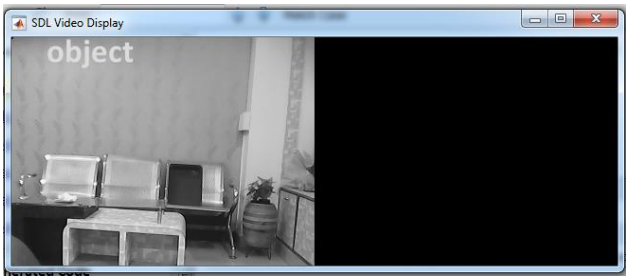

Fig. 9: Background image 2

Fig. 10: One abandoned object detected

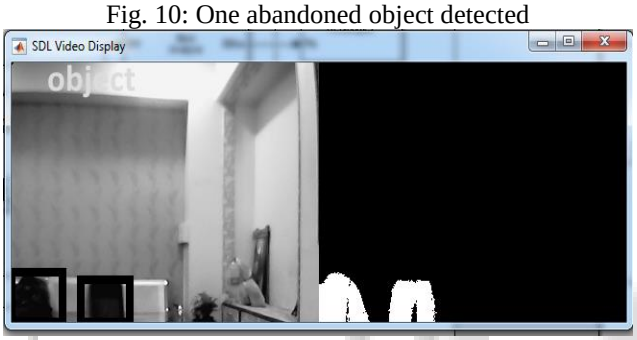

Fig. 11: Two abandoned objects detected

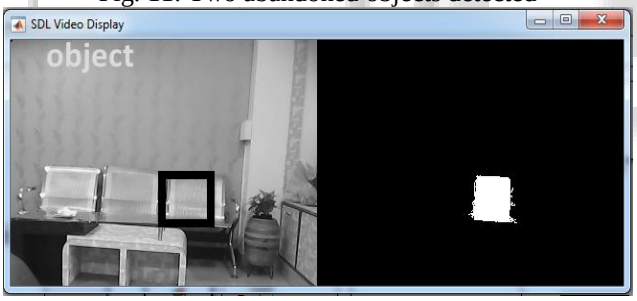

Fig. 12: One missing object detected

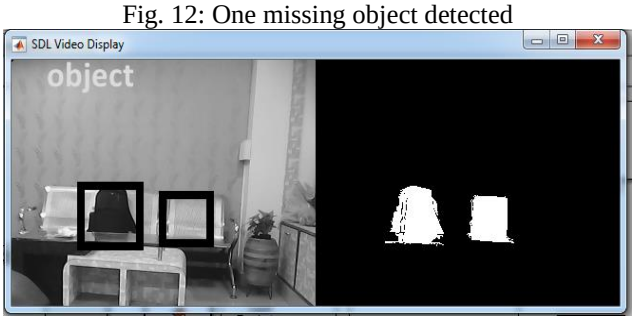

Fig. 13: One missing and one abandoned object detected

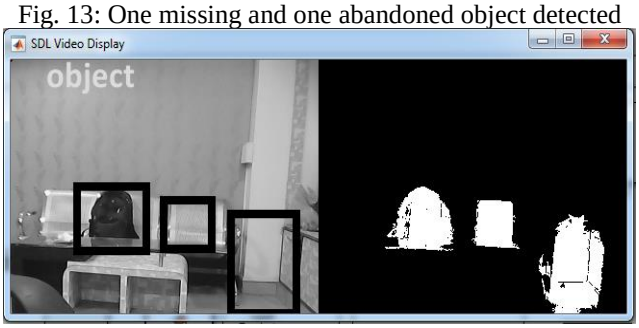

Fig. 14: One unattended and two missing objects detected

V. CONCLUSION

In this paper system for abandoned object detection is implemented. As started by a first step is to extract the images from video sequence. The second step is to apply background subtraction algorithm between the background and current image. Next step is to detect unattended events by analyzing the boundaries of static foreground regions. When unattended events get detected Finally, the result of detection will alert on the output alarm gets turn as indication for the detection of the event. System also detects missing objects in the video sequence.

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