

# MOVING OBJECT DETECTION USING BACKGROUND SUBTRACTION ALGORITHM USING SIMULINK

Mahamuni P. D<sup>1</sup>, R. P. Patil<sup>2</sup>, H.S. Thakar<sup>3</sup>

<sup>1</sup>PG Student, E & TC Department, SKNCOE, Vadgaon Bk, Pune, India

<sup>2</sup>Asst. Professor, E & TC Department, SKNCOE, Vadgaon BK, Pune, India

<sup>3</sup>Asst. Professor, E & TC Department, SKNCOE, Vadgaon Bk, Pune, India

## Abstract

Background subtraction methods are widely exploited for moving object detection in videos in many applications, such as traffic monitoring, human motion capture and video surveillance. How to correctly and efficiently model and update the background model and how to deal with shadows are two of the most distinguishing and challenging aspects of such approaches. This work proposes a general-purpose method which combines statistical assumptions with the object-level knowledge of moving objects, apparent objects (ghosts) and shadows acquired in the processing of the previous frames. Pixels belonging to moving objects, ghosts and shadows are processed differently in order to supply an object-based selective update. The proposed approach exploits gray color information for both background subtraction to improve object segmentation. The approach proves fast, flexible and precise in terms of pixel accuracy. The implementation of the background subtraction algorithm is done in two domains code is written in Matlab, then using Simulink blocks sets.

**Keywords**—Motion detection, Background subtraction algorithm, real time, Matlab/ Simulink, Xilinx.

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## 1. INTRODUCTION

In construction automation, the tracking of worker location or a moving object is important for labour monitoring, resource management, and machine coordination. For object tracking, a camera is often utilized to obtain information of construction vehicle motion which can then be employed in coordination controls. Real-time tracking of autonomous vehicles, particularly for the control of multiple targets in formations, still suffers from constraints imposed in computation resources. CMOS camera is used for in a prototypical tracking system for vehicles to detect their color-tags. The digital camera has become a popular sensor for monitoring and surveillance systems. By improvement of the semiconductor technology, modern digital cameras with high pixel number can provide greater image detail in various applications. A digital image sensor usually utilizes an array consists of the charged-couple device (CCD) or complementary metal oxide semiconductor (CMOS). By passing light through the lens and color filter array (CFA), the real image is transformed into the mosaic-like RGB image projected on the digital image sensor array. The raw RGB image then is reconstructed as a meaningful image for human perception by de-mosaicking and color correction. For sensing applications, the additional image processing to extract object is required for every image pixel. Moreover, it should be noted that imaging processing consumes a lot of memory space and most of computation resources in a computer system.

The moving object detection is an important task in the image sequences of the area which is under surveillance. Detection of moving object is necessary for surveillance application, for guidance of autonomous vehicles, for

efficient video compression for smart tracking of moving object, remote sensing, image processing, robotics, and medical imaging. The moving object detection is the initial step in object recognition. The aim of moving object detection is at extracting moving objects that are of interest in video sequences with back-ground which can be static or dynamic. The algorithm mostly uses either temporal or spatial information in the image sequences to perform moving object detection, and the most commonly used approach is pixel intensity. The algorithms for moving object detection have been proposed in the literature, most of them can be categorized into one of the three most popular approaches. Some of them can perform moving object detection in real-time, they include background subtraction. There are basically two problems one is processing speed and second is reliability of the moving object detection, and also the measure of quality related algorithm of two major indexes. The moving object detection can be done into three categories, including optical flow method, frame difference method and background subtraction method. And each one has its own advantages and disadvantages [1].

Nowadays the real-time information is very important in the surveillance area such as in military reconnaissance, mobile robot navigation, path planning the motion detection is very important thing. So in proposed system the digital camera is used for tacking the video of the area. Basically there are three techniques which are used for the motion detection in the sequence of the images such as temporal difference, optical flow and background subtraction algorithm. Out of these background subtraction algorithm is used. This algorithm will subtract the background from the frame to get

the moving object in the frame. The idea of background subtraction is to subtract or difference the current image from a reference background model. First of all, establish a reliable background updating model based on statistical and use a dynamic optimization threshold method to obtain a more complete moving object.

## 2. LITERATURE SURVEY

The video surveillance has long been in use for monitoring security sensitive areas for examples banks, department stores, traffic monitoring on highway, public places which are crowded. Due to the advanced technology the large capability of storage devices are available.

### 2.1 Motion Detection Methods

The motion detection methods are classified according to the method of finding moving object [1].

Different motion detection methods are described as follows:

1) *Temporal differencing*: The Frame differencing method uses the two or three adjacent frame based on time series image to subtract and gets difference images, its working is very similar to background subtraction after the subtraction of image it gives moving target information through the threshold value. This method is [3,4] simple and easy to implement, and also it is similar to the background subtraction. But this method is highly adaptive to dynamic scene changes, however, it generally fails in detecting whole relevant pixels of some types of moving objects. Additional methods need to be adopted in order to detect stopped objects for the success of higher level are computationally complex and cannot be used real-time without specialized hardware.

2) *Background subtraction*: it is particularly a commonly used technique for motion segmentation in static images. It will detect moving regions by subtracting the current image pixel-by-pixel from a reference background image that is created by averaging images over time in an initialization period. The basic idea of background subtraction method is to initialize a background firstly, and then by subtracting current frame in which the moving object present that current frame is subtracted with background frame to detect moving object. This method is simple and easy to realize, and accurately extracts the characteristics of target data, but it is sensitive to the change of external environment, so it is applicable to the condition that the background is known[4].

3) *Optical flow*: The optical flow method uses the motion target of the vector characteristics which changed with time to detect motion area in image sequences. It gives better performance under the moving camera, but this algorithm is very complex and complicated computation and also it needs special hardware support, so it is difficult to meet the requirements of real-time video processing [7].

## 3. SYSTEM DESIGN

In this paper, Moving object is described using background subtraction algorithm. Motion detection methods are basically a process which detects the object in the surveillance area [1].

The moving object in the frame sequences is detected using background subtraction. For motion detection, two images preferably of the same size are taken from video. In that one image is initialised as the background image in which the moving object is not present and the second image is the current image. And each image has two models one is the foreground and background model. The Fig.1 shows the system block diagram.

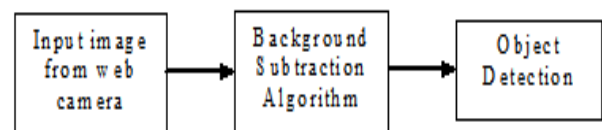


Fig. 1 System Block Diagram

The foreground model is the model in which the moving object is present and background model is the model in which the moving object is not present. The first process for motion detection is image initialisation. Image initialization is process that initializes the background image. For example, in the video the number of the frames with respect to the time, out of these frame one is initialized as the background image by tacking some assumption. Hence initialization of background is essential preprocessing operation for motion detection. And the preprocessing is done on each frame and the preprocessing is done by the mean filter for reducing the noise from the image. After the preprocessing the frames are given to the background subtraction algorithm. That subtracted image is then segmented using Thresholding. The background subtraction algorithm is design in the Matlab using Simulink block sets.

### 3.1 Software Design

In this paper, background subtraction algorithm is used for the detection of motion in the surveillance area. The Fig. 2 shows the flow of the background subtraction algorithm based motion detection process which consists of the video as the input. Here for tacking video CMOS sensor camera is used.

1) *Video to frame conversion*: Video is nothing but the series of frames with respect to time[2]. Videos are image sequences over the time. A video is a function of  $x, y, f(x, y, t)$  over time  $t$ . The camera will take continuously capture the images. So directly processing on the video is not easy it is difficult. So the conversion of the video into frame is done. It will give the frames at different time period. The Fig. 3 shows how the video is converted into the frames. Once the frames are ready then the processing is done on them.

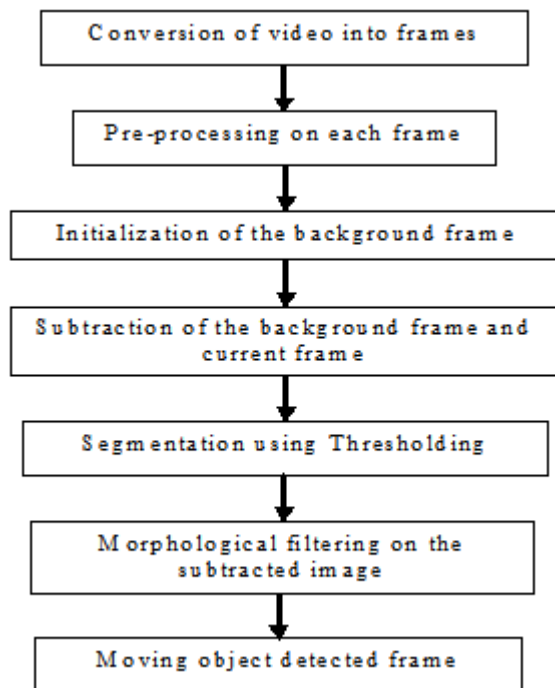


Fig. 2 Flow of background subtraction algorithm

2) *Pre-processing*: After the video to frame conversion pre-processing is done on each frame to reduce the noise which is present in frame. The pre-processing is done using the mean filter, convolution filter, median filter [6,1]. The mask of the filter will multiply with the frame and noise will get removed so that the result is accurate. Due to this only the background or foreground objects are preset and unwanted factors in the frame presents at the time of the capturing the images like dust.

3) *Background frame initialization*: Now after the pre-processing is done the background frame initialization is very important. Once the background frame is initialized it will referred as the reference frame. There are many ways to obtain the initial background image. For example, take the first frame as the background directly, or the average pixel brightness of the first few frames as the background or using a background image sequences without the prospect of moving objects to estimate the background model parameters.

4) *Background subtraction*: After the background frame is initialized the subtraction of the current frames and the reference frame is done for the moving object detection [1-5]. The subtraction will be done pixel by pixel  $(x, y)$  of the both frames. The simple version of this scheme where a pixel at location  $(x, y)$  in the current image  $f(x, y)$  is marked as foreground if

$$|f(x, y) - B(x, y)| > T_d \quad (1)$$

is satisfied where  $T_d$  is a predefined threshold. The background image  $B$  is updated by the use of an Infinite Impulse Response (IIR) filter as follows:

$$B_{t+1} = \alpha I_t + (1 + \alpha) B_t \quad (2)$$

$I_t$  is marked as the foreground frame. The above equations gives the foreground pixels and the updated background if the background is changes as the object is moving from one point to another then the updating the background is necessary. So that updated background is given to the reference frame. Then the subtraction of the current frame and the reference frame is done. And that subtracted image is given to the segmentation [8].

5) *Segmentation*: After the subtraction of the frames the subtracted image is then segmented using the threshold value. That value is practically set. The segmentation can be done as follow

$$D_k(x, y) = 1 \text{ for } |F_k(x, y) - B_{k-1}(x, y)| > T \\ 0 \text{ for others} \quad (3)$$

The above equation gives the segmentation after the subtraction of the current and reference frame. That subtracted frame gives the subtracted value of the each pixel that pixel value is compared with the threshold value if the subtracted pixel value is greater than the threshold value then it will represented by the 1 and if not greater then represented by 0. In image processing the value of 1 is black and 0 is white. So the segmented image gives the moving object in white and the background is black. It will detect the moving object in the frame.

6) *Morphological filtering*: The segmented frame is now given to the morphological filtering for reducing the noise. The function of the morphological filtering is removing the small regions probably created by noise, fill up unnecessary cavities, smoothing boundaries, extracting edges. It will give pixel level operations.

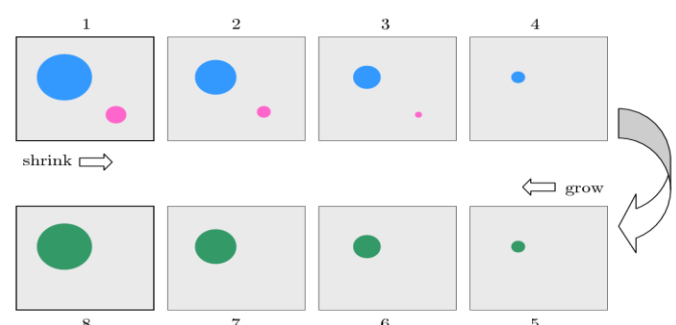


Fig. 3 Spread out and shrinking image region

The above Fig.3 shows the how the morphological filter will shrinking and growing shape of the circle.

7) *Motion detection*: After the segmentation and morphological filtering the moving object is clearly seen in the frame and that will be the output of the our system which is display on the VGA monitor.

### 3.2 Simulink Software Model for Motion Detection

The Simulink model shown in Fig. 4 is prepared in matlab with the help of Simulink library browser which contains the Image and Video processing block set. The software model for motion detection consists of Image from file, Video Viewer, Embedded function block, parameter blocks. Both the input images are displayed using the video viewer block. Each time we run the Simulink model, the different image dataset has to be selected.

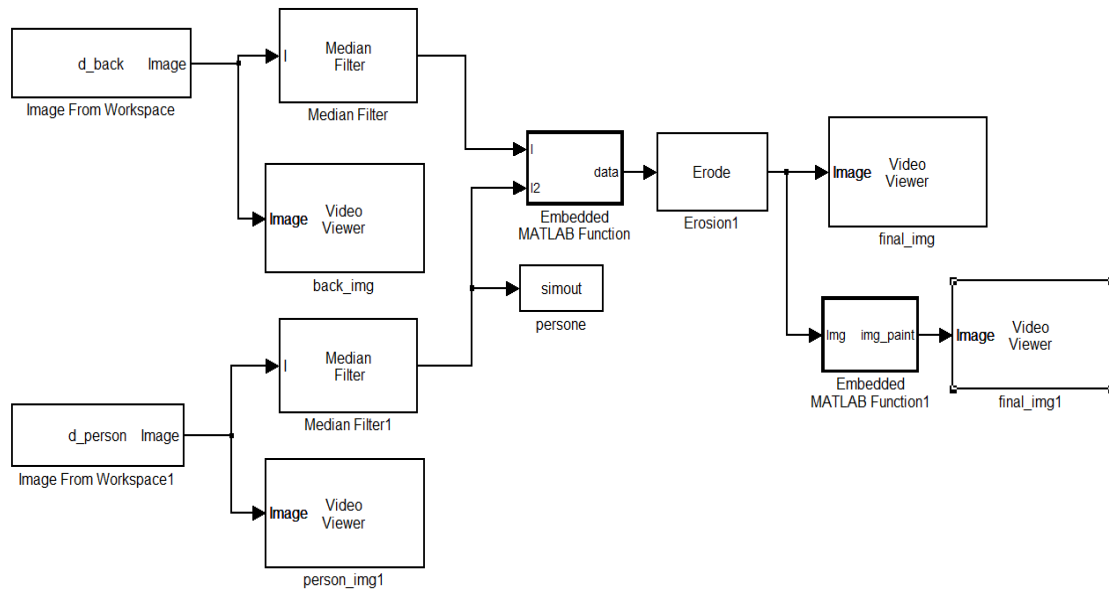


Fig. 4 Simulink Software for Motion Detection

2) *Video viewer*: This block is used to display the clock images in matlab. The input images, input image 1 and input image 2 are displayed using this block. The output clock image is also displayed using this block.

3) *To Workspace*: This block is used to store the clock images in matlab workspace for further processing, where we get the details of image such as size, pixel information etc.

4) *S Function Block*: Embedded function block for motion detection using background subtraction algorithm. This block is also called as S-function block, where we actually do the scripting by embedding the code for the designed algorithm. This block is programmed using matlab commands. The subtracted clock image is then displayed using Video Viewer block.

## 4. EXPERIMENT RESULTS

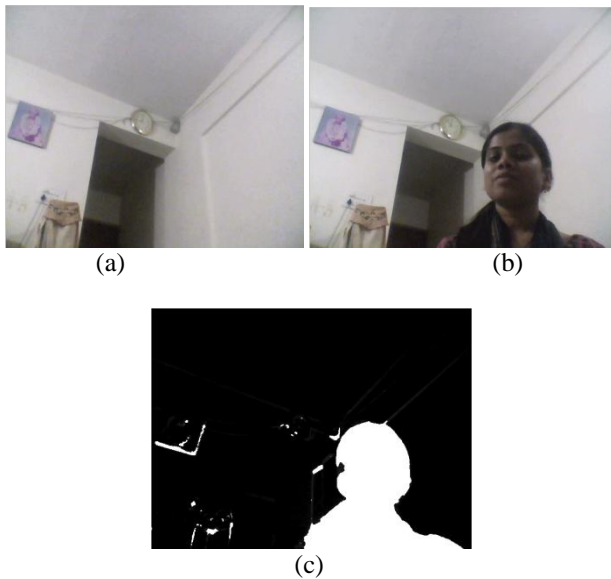
In this experiment we use the background subtraction algorithm for the detection of the moving object in the surveillance area. The demonstration system has the set up for the implementation of proposed system in the Matlab software.

1) *Image From File Block*: This block is basically used to access the two input images which are to be subtracted. By double-clicking on this block, we have to select the path

where the two input images are stored. Two input clock images of size  $256 \times 256$  are taken as input images. Each time to run the model for different dataset; we have to give the path of input images.

Here the reference image is initialized in the code and then the subtraction of the current frame is done. And after the subtraction of the both frame the subtracted image is display on the screen. The following figure shows the reference image, current image and the subtracted image. The subtracted image shows the moving object in the white colour and the background is black. The coding is done in Matlab and the following results are seen. In the Matlab coding the initialization of the web camera of lab-top is done and it will captured the video. That video gets subtracted from the reference image. The reference image is nothing but the background image in which the object is not present.

The Fig 5(a) shows the reference image which is initialized as the background image. This image is referred as background image because there is no any moving object. In the real time extraction the background image processing approach is used to provide the most complete feature dataset, but it is extremely sensitive to dynamic scene changes due to lighting and extraneous events. Background image is not fixed and it must adapt to motion changes like tree branch move, changes in background because of objects entering in a scene, stay for longer period without motion.



**Fig. 5** (a) Reference image (b) Current image (c) Output image

The Fig 5(b) shows the current frame which is subtracted from the reference image. In the current frame the moving object is present. So when the subtraction of the reference and the current is done the moving object is detected in the final image. In the current frame more than one moving object is present and those moving objects are also detected by this algorithm. It will also detect the some insects which are present in the image

The Fig. 5(c) shows the output image in which the moving object is detected. The subtraction of the image is done pixel by pixel so the background of the current image and the reference image has the same pixel value due to this subtraction of the background pixel is zero so it will be represented in the black colour and the moving object is represented by white colour.

So at the end the output image is the binary image. After the binary image getting the morphological filtering is applied to that image and it will perform the operation like opening, closing, sharpening the edges and it will also remove the noise from that frame.

## 5 CONCLUSIONS

In this work, Background subtraction algorithm based motion detection using a Matlab coding, Simulink. The software reference model of the chosen architecture is developed in MATLAB/ Simulink. Improving segmentation results as well as being able to extract additional information such as frame deference, background subtraction allows for improved object detection and thus tracking. The subtraction of the two image is gives the good results of the moving object in the surveillance area. The resultant subtracted frame contains the information or data from both the input frames. It provides an effective way of detecting moving object. It will gives better information of the moving object in video as compared to another algorithms.

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