

# Full Body Motion Detection and Surveillance System Application

Jay Sawant<sup>[1]</sup>, Darshana Sankhe<sup>[2]</sup>

<sup>1</sup>Student, Dept. of Electronics Engineering, D.J Sanghvi College of Engineering, Mumbai, India

<sup>2</sup>Professor<sup>[2]</sup>, Dept. of Electronics Engineering, D.J Sanghvi College of Engineering, Mumbai, India

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**Abstract** –Image processing is an approach of obtaining some useful information by modifying an image into digital form by performing some operations on it. For detecting motion in a video, it can be treated as a stack of frames. While comparing these stacks with each other accurate motion can be detected. Object detection and tracking are the tasks that are significant and demanding such as Accurate Realtime Full-body Motion Detection. Tracking of objects from an image is current research with widespread application used in surveillance. The main goal of the project is to track body motion in real time using OpenCV which can be used for different applications like surveillance systems, pose estimation and different filter applications.

**Key Words:** Motion Detection, Image Segmentation, Image Subtraction, Edge Detection, Surveillance System

## 1. INTRODUCTION

Image processing is being used in numerous areas of applications. Image processing is an approach to transform an image or video frames into digital form to execute some operations on it, in order to get an enhanced image or to extract some effective information from it. The input can be an image, like video frame or photograph and output may be an image or its characteristics. Generally, set signal processing techniques are used on the image, treating images as two-dimensional signals. Image processing has become even more significant after the advent of modern imaging devices. Initially, it is used to improve the quality of an image, also, to perform a number of operations to obtain the desired result for the creativity of an image. But later, it has been realized that this technology could be utilized for much bigger purposes such as Video processing, Surveillance systems, filter applications etc. Image processing can be used in every possible fields such as security, gaming, medical etc. The time delay to obtain the desired output is the only drawback of this technology.

Security is a vital issue in current world. The three main categories i.e. visual tracking, biometrics and digital media security can be used to solve various aspects of security in daily life. Visual tracking is the technique which uses computer vision techniques that analyses the scene to extract the useful information such as an object which is further fed as an input to analyse and detect any anomalous behaviour. Biometrics is used to detect and analyse human's physical features which is used for identification purposes. For example, the use of biometrics in Border control and Airport security. Digital media

security uses watermarking approaches to embed one image into another for security purposes in media content.

Motion detection relates to the proficiency of the surveillance system to detect motion and capture the events in video surveillance. Motion detection is generally a software-based monitoring algorithm which detects motions using the camera to capture the event. Any features such as warranting an alarm can be implemented for advanced motion detection surveillance system.

Image processing is an approach of obtaining some useful information by modifying an image into digital form by performing some operations on it. For detecting motion in a video, it can be treated as a stack of frames. While comparing these stacks with each other accurate motion can be detected. Object detection and tracking are the tasks that are significant and demanding such as Accurate Realtime Full-body Motion Detection. Tracking of objects from an image is current research with widespread application used in surveillance. Tracking of body motion in real time can be done using many methods, one of the examples is using Python and OpenCV. This can further be used for numerous applications like surveillance systems, pose estimation and different filter applications. Analysis of human motion is one of the most recent, demanding and popular topics in the field of Image Processing. A variety of practical applications can be implemented using this technology, such as Intelligent Surveillance, face detection, object detection etc. By interfacing more sensors like ultrasonic, IR, temperature sensors etc, the accuracy can be further improved and can be used for many industrial applications. Our focus of this project is to propose an approach that deals with efficient human motion detection in two dimensions.

Python is an open-source, general purpose programming language which is object-oriented, procedural and functional. It has a great interactive environment. It can be easily interfaced with C, C++, JAVA etc. There is a large collection of proven libraries and modules. The modules are easy to install. Few of the useful modules or libraries includes numpy which provides the capability of MATLAB functions such as linear algebra, 2-D arrays, multi-D arrays etc. Similarly, matplotlib provides high quality plotting library. The library cv2 provides dilation, thresholding, Gaussian blurring etc.

Open Computer Vision Library (OpenCV) provides the face and body detection function along with the contouring function. The contouring functions can find and draw the contours of an object and/or body.

Furthermore, different methods such as video recording and different processing techniques such as thresholding, gaussian filtering, dilation, colour to grey scale images and vice versa, contour finding, contour drawing etc are used. Contours is defined as a curve joining all the continuous points (along the boundary), having same intensity or colour. The contours are a useful tool for object detection, object recognition and shape analysis. Thresholding, a type of image segmentation is used to partition an image into foreground and background that isolates objects by converting a grey scale images into binary images. Morphological operations include dilation and erosion. In dilation, extra pixels are added to the boundary of the object in an image whereas, erosion removes few pixels from the boundary of the object in the image. The structuring element is used to add or remove the pixels to or from the object. The size of added or removed pixels depends on the size and shaped of the structuring element used in the morphological operations. Image noise and detail is reduced by a Gaussian function which is called as Gaussian smoothing or Gaussian blur.

Our project aims to detect human motion in real time. One of the general principles include comparing two frames to obtain an output which could be further processed for the desired objective. This is incorporated in multiple applications. One of which includes detecting the motion of an object, thereby, producing an outline structure of that particular object/body using contours functions. Second application includes detection of human motion and generating a rectangular box around it, indicating a motion within the frame. Another one includes the detection of an object/body in real time by comparing the first frame with the current frame. Thus, obtaining the results which indicates the status as occupied or unoccupied.

## 2. IMAGE SEGMENTATION AND SUBTRACTION

As discussed, the primary step of a motion detection algorithm would be the foreground-background segmentation step. To piece out the fore from background there's a bunch of procedures feasible. A motion detection algorithm commences with the segmentation part where moving objects are segmented from the environment. The easiest approach to achieve this is to pick up an image as background and select the frames received at the time  $t$ , denoted by  $I(t)$  to match with the environment image denoted by  $B$ . Here using basic arithmetic computations, we can segment out the bodies simply by using image subtraction technique of computer vision meaning for each pixels in  $I(t)$ , select the pixel value denoted by  $P[I(t)]$  and deduct it with the corresponding pixels at the same position on the environment image denoted as  $P[B]$ .

In mathematical equation it is written as;

$$P[F(t)] = P[I(t)] - P[B] \quad (1)$$

Where  $F$  refers to the foreground or resulted image after the calculation at moment  $t$ .

The development of this most basic method is based on a passive background meaning no modifications are carried out onto the background. The environment is estimated to be stationary and never altered even a slight bit. The brightness of light and other changes which typically would take place as modifications to the environment is entirely neglected in this algorithm. Thus, a better-defined program should be achieved to enhance this issue and hold these factors into interest. In image subtraction, the term subtraction gives value of given two figures  $A$  and  $B$ , either  $A$  subtracts  $B$  or  $B$  subtracts  $A$  which may bring to a non-desirable proceeding. Thus, normally we used a definite subtraction technique where the end of  $A$  subtracts  $B$  and  $B$  subtracts  $A$  are essentially the same. The problems discussed were established by them as specific difference pictures, negative difference pictures and absolute difference pictures respectively. An essential technique was found to segment objects using motion. Since the proceeding of an absolute subtraction technique provides both the change of the current frame and the environment, an edge detection mechanism is employed to the present frame and the result of subtraction and the end of the edge detection is connected using the AND operator. This suggests an approach which links the spatial and temporal gradients. Also, an accumulative difference picture system was adopted to provide more powerful change detection. This procedure can be completed in the process of amending the environment picture which will be considered subsequently.

## 3. MOVING EDGE DETECTION

Practicing edge detectors aids in achieving a cleaner interpretation of the changing bodies. Using edge detectors blending with the other images will provide a stronger result for motion detection by aiding to reduce several limitations. There are many edge detectors flowcharts introduced in the image processing field. Mostly all content on picture processing does deal with the subjects on edge detection. The determined 3 steps in edge detection designs are:

- Filtering
- Enhancement
- Detection

Some first derivatives operator masks used for edge detectors are Roberts operator, Sobel operator, Prewitt operator. Other used second derivatives masks such as Laplacian operator. We are using Gaussian edge detection techniques, a popular known method which uses it is the Canny edge detector.

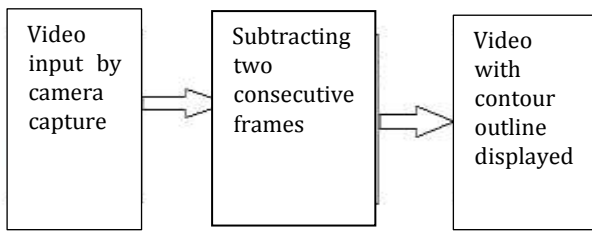


Fig-1: Simple steps for contour detection.

### 3.1. MOTION DETECTION APPROACHES

There are many ideas chosen by scientists to achieve motion detection. Here we would discuss the traditional background modelling approach which renews the environment based on statistical data Background modelling

Background does not consistently remain the same. Thus, to develop the most basic algorithm explained in the preceding case, we make B into a 1D space. For example, let  $t_2$  denotes the time that a background is revised. An updating function denoted by  $F_n[B(t_2)]$  applies to the function to amend the environment image B at moment  $t_2$ .

Therefore, after executing the original computation, the foreground is now extracted from this unique background denoted by  $B(t_2)$ . Thus, turning the equation (1) into;

$$P[F(t)] = P[I(t)] - P[B(t_2)] \quad (2)$$

Where  $B(t_2) = F_n[B]$  meaning  $B(t_2)$  is worked out by a modernizing function that is executed on the preceding background. One approach is by utilizing data assembled from the frames and produces some computation on the background image. One example is to select or read down all the pixels of all the frames before time  $t_2$ . After that, simply sums them up and count the average value and amend the environment B to get a new background  $B(t_2)$  with this average value. However, there have been many forms to amend the backdrop.

To be precise, this part of the project is simply concentrated on the motion detection algorithm and extended to application of surveillance system. Thus, in the next unit we would provide a sketch design of the project and the procedures and technique which we had carried out after the research had been wound up.

### 3.2. SURVEILLANCE SYSTEM APPLICATION

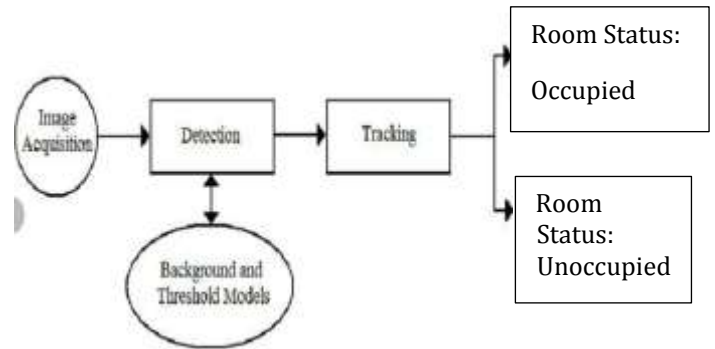


Figure 2 Block Diagram Surveillance system

It is a technology which is aimed at interpreting human body with the help of mathematical algorithms. Movement recognition technique basically focuses on the changes happening in the room based on the first frame or initial frame. The body is differentiated from other moving objects this way also by tracking further uses like alarm implementation or changes in the camera based on the movement of the body detected can be made. Here without using any expensive software's or high-tech camera using a simple single depth computer camera room status can be checked.

### 4. RESULTS

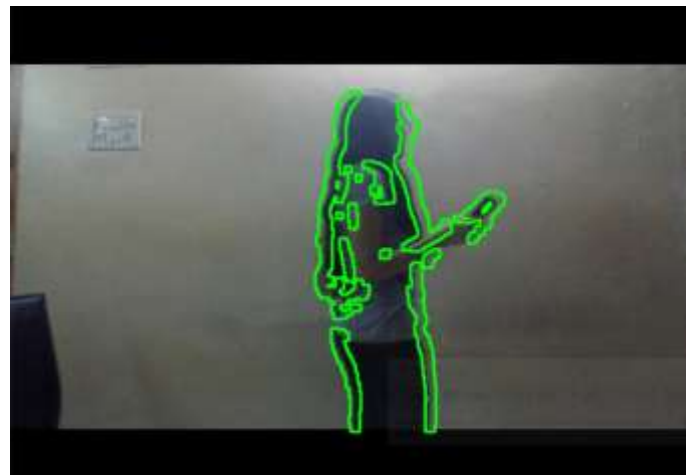
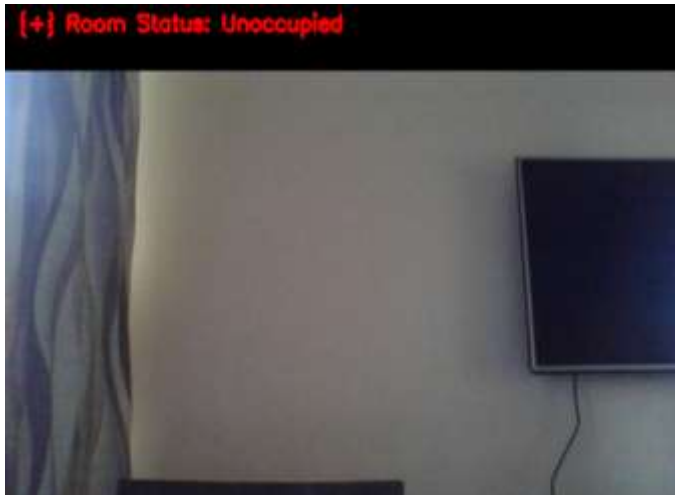
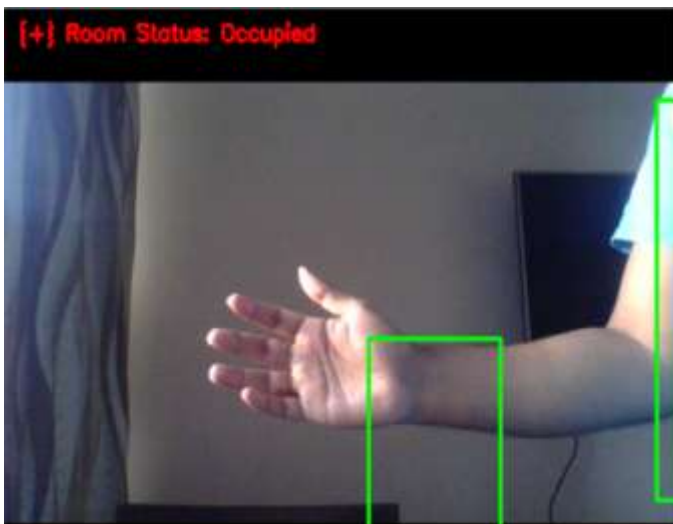


Figure 2 Body detection of multiple people in the current frame.

The body detected is highlighted by a square since 4 points are used to detect the body. Using more points may give a better outline but will lead to lagging of the system. On basis of this body detection filter applications can be developed easily along with the surveillance system application that we have implemented. Simple motion is detected by comparing two consecutive frames of the video captured through webcam in real-time, thereby, resulting in the contours i.e. the outline to the boundary of the body.



**Figure 3** An empty room indicating its current status as unoccupied.



**Figure 4** Any movement or change in the room is detected and the status changes from unoccupied to occupied.

## 5. CONCLUSIONS

We have made the use of Python, an open source software which supports a number of libraries and modules to implement easy yet effective application of motion detection to create applications like surveillance system, motion detection and filter implementation.

Successful implementation of motion detection using finding and drawing contours around a moving object/body is done in real-time by comparing two consecutive frames of the video captured through the webcam. This is done by implementing different processing techniques such as Gaussian blur, thresholding and dilation on the grey scale image followed by using the functions of contours.

Room monitoring system and surveillance system is implemented using required libraries or modules by importing cv2, pandas, datetime and time. This system compares the first frame with the current frame to generate the output. If the first frame is the same as the current frame then the output indicates the room status as unoccupied. Whereas, if the first frame is not the same as the current frame i.e. when there is any movement or any other object present in the current frame then the room status becomes occupied.

## REFERENCES

[1] Real-time Human Motion Detection And Classification  
Farhan S. Khan, Salman A. Baset GIK Institute, Toppi

<http://www1.cs.columbia.edu/~salman/publications/motiondetection.pdf>

[2] RESEARCH ON CAMERA-BASED HUMAN BODY TRACKING USING IMPROVED CAM-SHIFT ALGORITHM  
Jiude Li Linyi University, College of Physical Education, Linyi, Shandong, China

<http://s2is.org/Issues/v8/n2/papers/paper14.pdf>

[3] Human Motion Detection, Tracking and analysis for Automated Surveillance

Eyup Gedikli, Murat Ekinici Computer Vision Lab.  
Department of Computer Engineering

Karadeniz Technical University Trabzon 61080, Turkiye

[https://www.researchgate.net/publication/228867094\\_Human\\_Motion\\_Detection\\_Tracking\\_and\\_Analysis\\_For\\_Automated\\_Surveillance](https://www.researchgate.net/publication/228867094_Human_Motion_Detection_Tracking_and_Analysis_For_Automated_Surveillance)