

## Video surveillance system with motion detection in real time video

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### Abstract

The wide spread cases of theft resulted in the need for designing and implementing an effective and reliable intrusion detection system. An attack is a common phenomenon in homes, offices, factories and public institutions. With the use of a technology, motion can be detected by measuring change in speed of an object under a camera view in restricted areas such as server rooms, offices and so on. The motion detector is used as an intrusion detector and sends security alarm to the user, the security administrator. In this study, we have employed the built in camera in Laptop for capturing live video stream and we developed a system capable of detecting suspicious activity in a restricted area and then generating an alarm automatically. Once motion is detected, the system sends an email message automatically to the user, the security administrator.

**Keywords:** video surveillance, motion detection, real time video, security

### 1. Introduction

Motion detection is the process of identifying the change in position of an object relative to its surrounding or the change in the surrounding relative to an object. This paper is proposed to use the novel approaches (latter discussed in detail in the following section) to implement a complete framework that allows a real-time detection and motion-based tracking of moving objects in a video stream acquired by a stationary camera.

Machine vision research includes several important topics, one of which is detecting and tracking moving objects. Detecting and tracking moving objects' in a real time video scene is progressively gaining importance for security and surveillance. It has a number of applications such as moving object analysis for video surveillance, traffic monitoring and human detection and tracking in indoor environment.

Extraction of moving objects in a video sequence and estimation of corresponding motion trajectories for each frame is one of the distinctive problems of interest in computer vision. However, in real environments moving object extraction becomes challenging due to factors such as, brightness or illumination, static or dynamic object types which may result in insignificant for moving object extraction. Although it is a challenging task, tracking objects' in video sequences is an important topic in the field of machine vision and various research fields. Object tracking aims at deriving the trajectory over time of moving object in video sequences and it has various applications in the areas like security, surveillance, clinical applications, biomechanical applications, and human robot interaction.

Moving object detection and tracking is a very difficult task in the presence of inconsistency illumination condition, background motion, complex object shape and if the captured frame is noisy. This makes extraction of moving objects very difficult task to detect the motion of an object with higher precision and high accuracy from image sequences in real time video input. Any motion detection algorithms, such as background subtraction and frame subtraction, needs to handle a number of critical situation<sup>[1]</sup>. These situations induce motion in irrelevant areas inside the

scene. Proper handling and management of these situations is required to accomplish a nearly exact motion detection system. Therefore, motion detection and tracking objects is A difficult task due to the following critical situations:

- Noise in the image, due to poor quality of the captured image/video source.
- Variations in lighting conditions in different parts of the same object.
- Gradual and sudden changes in the light conditions.
- Objects moving so fast that they are captured in only a single frame of the whole scene.
- The inefficiency of motion detection, algorithm.

Based on the open issues on motion detection which are listed above, the following research questions are formulated and this study

1. What is the problem of applying different filters in motion detection?
2. Which motion detection model has better performance on motion detection?
3. How does the performance of motion detector be optimized?

### 2. Literature review

Under this section, the researches which are related to motion detection system, video processing and video surveillance will be reviewed<sup>[1-5]</sup>. The methods or algorithms used in moving target detection, include, the background subtraction, frame difference and the optical flow<sup>[2]</sup>. In the background subtraction method, a moving object is detected by subtracting the background from the moving parts. The difference frame is the threshold and the amount of the difference is calculated. To suppress stand-alone noisy pixels erosion morphological operator may be applied, which is controlled by suppressing noisy property. And the frame difference method detects moving objects by measuring the frame difference between sequences of frame in the video. The frame difference method is an algorithm for motion detection where a moving object is detected based on two continuous frame differences. The background

subtraction builds static image which is used as a background image and compares every frame with this static image to detect a moving target in the video or live image under the camera view [3]. Motion detection is very important in security. Server rooms and restricted areas can be constantly monitored by using motion detection systems, by using video capturing tools and sending an alarm or alert such as an email to the user when a moving object is detected [4] suspicious activity in the area can be protected. A video surveillance systems are very important in security, accident detection and object recognition [5]. In security, smart surveillance system sends an automated alarms to security administrator, when suspicious activity is detected by the surveillance system. the surveillance system are also very important in accident detection, specially traffic accidents. Object recognition is another importance of motion detection. It is the first step in recognizing objects, for example nsurveillance system, all the moving objects will be reported to the administrator, but these objects may be funs, leaves or other non living objects. Therefore, it is important to identify the type of object movig in the scene before the alert is raised. A modified method, background updating model is used in detection of objects in real time video surveillance system [6]. In this model the background is updated to achieve better accuracy in motion detection. The author has shown that, the accuracy is better than static background model.

### 3. The design of surveillance system

This section summarizes the overall design of motion detection for video surveillance system, covering the system's major components. The system is comprised of several important components, broken into application components to ensure modularity. The application components are the real time video capture, the motion processing component and a motion detector. Motion capturing routine is the systems' is a component that constantly captures real time video stream, which will be used in as an input to the motion detection and further motion processing. This routine captures video data from local video capture device, like USB web camera (or internal), anything which supports DirectShow interface. The motion processing component performs different operations such as gray scaling filtering. The gray scale algorithm used here is BT709 which converts color image to grey scale then some image filtering operation is also performed on the gray scaled images in video frame to avoid the noise in every frame taken as input from the video capturing component. After applying different image processing filters are applied to the frame and the frame is transformed, the motion detection component, performs the actual motion detection process by highlighting moving object in the video scene exactly identifying the moving objects' in the given video input. The sub components of the system and the motion detection process are shown in figure The system is composed of different subsystems which carry out the overall motion detection and moving object tracking process, different modules/components of the system and their relations is given in the figure 1.

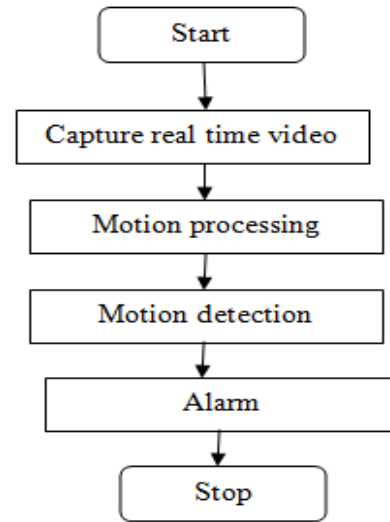


Fig 1: Motion detection process

As shown in the figure 1; the motion detection system is composed of the following components::

- Live video stream capturing
- Motion processing(for example applying Filters) and
- Motion Detection and Object Tracking

#### 3.1 Motion processing

The frame in the video may be noisy and the illumination, lighting conditions result in lower accuracy in motion detection. Due to this reason different filtering and image processing is applied to each frame for better result. Before a blob counters are applied to capture image to detect moving objects, it is necessary to process the data in order to assure that it satisfies certain assumptions implied by the method. The following video processing is applied to extract such useful information from the whole video scene:

- Noise reduction using erosion filter in order to assure that camera noise does not introduce false information and
- Contrast enhancement filters are applied to the captured image to assure that relevant information can be detected. Video pre-processing is necessary, in order, to remove the noise and to improve the quality of the image.

The main objective of this process is to improve the quality of the video to make it ready to further processing by removing the unrelated and surplus parts in the video. This component plays a vital role in processing the real time video stream to exactly identify moving objects the video. In the proposed system, the algorithm used is motion area highlighting algorithm which is aimed to highlight, as shown in figure 3, the borders of motion areas found by motion detection algorithm.

#### 3.2 Motion detector

The motion detection component detects the motion of an object. To clearly identify moving objects in the real time video, background and fore ground objects must be

separated to ignore the static or nonmoving portion of the video. Color filtering is applied to separate the background from the real time video objects. After separating the background from the real time video objects the motion detection algorithms are applied to the video in order to detect the moving objects highlighting the motion border of only moving objects from the entire real time video stream indicating the objects in motion from the given real time video input. The next process after separating the background from foreground objects and identifying the moving objects in real time video sequence, the last motion processing performed is tracking those moving objects from the given video sequence. In order to locate a moving object (or multiple objects) over time in the real time video sequence using a camera Blob counting algorithm is used. This algorithm counts objects in image, which are separated by black background. 5 Objects with different properties in brightness, colors compared to the surrounding regions are considered as different blobs/objects in the video stream given as an input for motion processing by the blob counting algorithm and The algorithm treats all pixels with values less or equal to background threshold as the background, but pixels with higher values are treated as objects' pixels.

#### 4. Implementation of the motion detection system

This section, describes the implementation of object motion detection in real time video sequences using motionless web camera. The system is implemented using different software and hardware tools. We have used visual C# 2010 and AForge.NET library for implementation of the system. In order to detect objects motion and track the complete trajectory that moving object follows in real time video the entire problem is decomposed into smaller sub problems as follows:

- Motion Detection and
- Object Tracking

##### 4.1 Motion detection

To detect a moving object in sequence of video frames, a frame difference technique is used to compare each frame in the frame sequence with the current frame and if difference is found between each consecutive frame the difference is highlighted using two frame difference detector algorithm and motion area is detected.

##### 4.2 Object tracking

To track each of the moving objects in the given sequence of real time video captured from stationary web camera, the objects must be extracted first, to do so blob counting is used. Blob counter is used to get information's about each moving objects, by using filter that gets objects rectangle in order to track the objects boundary with rectangular box in the entire video sequences. The track followed by each of the moving objects in video scene is therefore indicated by this rectangular box drawn to each of the corresponding blobs or objects in the video. The algorithm used for this purpose is given below:

```
BlobCounter blobCounter = new BlobCounter ();
Blob [] blobs = blobCounter.GetObjectInformation ();
Rectangle [] rects = blobCounter.GetObjectRectangles ();
```

The motion detection and object tracking application is implemented by using different algorithms provided under AForge.NET framework which contains set of classes, which can be used to implement different motion detection and motion processing algorithms. The algorithms used in the implementation for detection and tracking the motion of an object in video stream include the following

1. Two frame difference detector The two frame difference detector algorithm is used to find the amount of difference in two consequent frames of video stream if there is difference between these compared consecutive frames in the video stream then the motion is processed by motion area highlighting to indicate that the object is in motion.
2. Motion area highlighting- this algorithm is used for motion processing, like highlighting of motion regions. It supports number of different video sources, which includes web camera. Given below is a simple code, which demonstrates main idea of working with two frame difference motion detection and motion processing using motion area highlighting algorithms:

```
// create motion detector
MotionDetector detector = new MotionDetector (new TwoFramesDifferenceDetector (),
new MotionAreaHighlighting ());
```

#### 5. Results & Discussion

In this section, the implemented system is described along with the systems' screen shots indicating how the system detects moving objects in real time video sequences. The system uses a graphical user interface developed using visual c# 2010 and through which a video stream is captured. All the interfaces are designed by using C# 2010 controls with the help of AForge.NET image processing libraries. The AForge.Controls namespace contains different useful UI controls, used together with other classes of AForge.NET framework. Video source player control is used to play real time video sequence and display the real time stream of frames captured from the motionless web camera as shown in figure 2.



Fig 2: A sample moving object (fun)

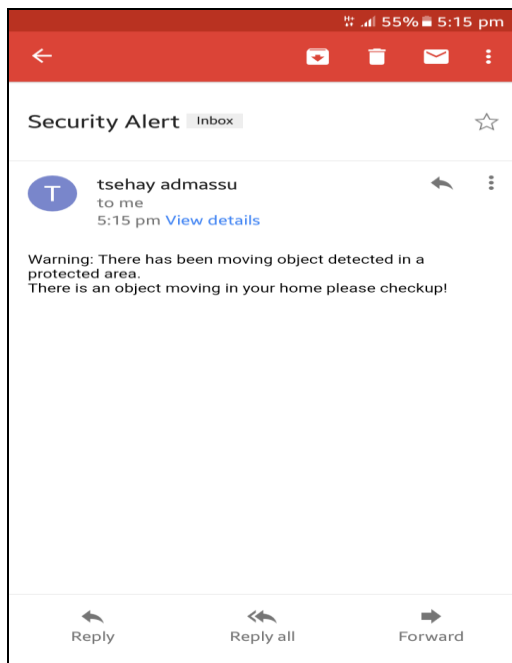
Figure 2 shows a fun in motion which is in the camera view. The video is captured using video source players implemented using microsoft visual C# 2010, the video player captures real time video, which is feed to the motion processing using three motion processing algorithms, namely two frame difference, custom frame difference and background modeling. All of the algorithms or motion detectors can detect the motion of object precisely. The

movement of the fan is detected as shown in figure 3.



**Fig 3:** Moving object detection.

Figure 3 shows an object which is in motion. The motion area is highlighted by the yellow color. Any suspicious activity in restricted areas can be detected and an email is sent to the security administrator, as shown in figure 4.



**Fig 4:** Security Alert Message

The email displayed in image 4, is automatically sent by the system when it detects a moving object in the camera view

**5. Conclusion**

Moving object detection in an image sequence is a very important low-level task for many computer vision applications, such as video surveillance, traffic monitoring, and sign language recognition. When the camera is stationary, a class of methods usually employed is background subtraction. The principle of this method is to build a model of the static scenes(i.e. without moving objects) called background and then to compare every frame of the sequence to this background in order to discriminate the region of the un usual motion, called foreground(the moving objects). In this paper, an algorithm for real-time object detection based on simple background subtraction has been implemented using A Forge libraries with Visual C# 2010 programming language. Video is captured with a

stationary Web camera, different motion processing algorithms have been applied on the captured live video, such as frame difference, custom difference and background modeling as motion detectors and finally the system detects moving objects in the captured video.

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