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Smart Surveillance System

Yash Gupta[1*], Samriddhi Mishra[2], Deepti Sharma[3]

[1,2,3]Department of Computer Science & Engineering, PSIT College of Engineering, Kanpur

**Corresponding Author: gupta27yash@gmail.com*

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Abstract — Motion Detection surveillance system is an advancement in the current era of technology. In this paper, we have proposed a technology to detect objects, to track moving objects, to eliminate noises and to save videos of our interest. This technique will be highly useful for both home and office needs as these areas demand a reliable surveillance system nowadays. The experiments conducted in accordance with proposed methods which are suitable for real-time surveillance system [1]. The main objective of this provide a secure surveillance system in areas such as ATMs or offices where recording takes place only when objects is present (in motion).

Keyywords—Background Subtraction; Robust Algorithm; Gaussian Mixture Models; Multiple Moving Object Tracking; Background Modeling; Blob Labeling; Group Tracking

I. INTRODUCTION

Typical video surveillance systems take huge amounts of storage space. By storing everything that the video camera records, consumes excessive storage and poses a hindrance to the duration of the video that is essential to be captured. Traditional surveillance systems had disadvantages in which the person had to monitor the closed-circuit televisions (CCTV) when necessary [1]. These limitations gave birth to the needs for an intelligent video surveillance system that can monitor and work in real time conditions. The advantages of this new technology are that it is of low cost and high efficiency when compared to previous ones. This paper has been written in order to provide an intelligent image processing technology for simple office or banking video surveillance systems.

In this paper two algorithms are used first is Background Subtraction Algorithm and second is Robust Algorithm for motion detection.

Background Subtraction Algorithm has been implemented to detect foreground objects in videos using static cameras. The approach is to detect the objects from the difference between the current frame and a reference frame, which is called "background image".

To detect and track the specific moving objects only, it is important to eliminate the environmental disturbances such as light scattering, waving of trees and so on. To eliminate this, we have used the difference image methods such as the background modeling (BM) or the Gaussian mixture model (GMM) [2]. However, they cannot track the moving objects smoothly when the objects are hidden by obstacles or the background has colours similar to theirs [3]. BM is used to detect such things with a sensitivity parameter to extract moving regions, eliminate noises, and to group the moving objects. Some of the challenges are shadows, wind causing cluttered areas to name a few. The drawbacks of earlier methods of Background Subtraction are that when moving objects, slow moving objects, illumination changes, reflections, shadows and noises like object overlapping in the visual field, camera movement, etc. are being introduced or removed from the scene, the algorithm might fail or may produce inappropriate results [3].To detect and overcome the above-mentioned situations the robust subtraction techniques are used in order to handle variations in moving scene clutter, lighting, multiple moving objects and other arbitrary changes to the observed scene. These methods are known as real time background subtraction techniques.

The paper has represented the algorithms in Section 2 and Section 3 which will help us to detect objects which are in motion and will remove noises and shadows if present and will enable us to track these objects even if they are present in clutters. In Section 4 we have represented how these proposed algorithms can be implemented in daily life surveillance by coming up with a working model under the name "Smart Surveillance System". The final experimental result has been obtained in Section 5. Finally, we have summed up our conclusions and future work under Section 6. Thus, enabling us to support our experiments with steadfast foothold by projecting the efficiency and the applicability of the proposed method.

II. BACKGROUND SUBTRACTION ALGORITHM

Background Subtraction Algorithm has found its use ranging from basic level implementation to advance level techniques. In our paper, we have implemented the algorithm as frame-based background modelling. Background subtraction draws its popularity from its computational efficiency, which allows tasks such as video monitoring, smart systems and traffic surveillance to meet their real-time goals [6, 7].

A. Frame Difference Technique Theory

The simplest method of background subtraction is the frame difference technique. The procedure simply acquires the current frame to be subtracted from the previous frame, and if the difference in pixel values for a given pixel is greater than a threshold T_h then the pixel is considered to be part of the foreground [5, 6].

$$\left| \text{frame}_i - \text{frame}_{i-1} \right| > T_h$$

The pros of this approach are that the computation speed is lowest and the background model is highly adaptive.

Frame Differencing technique which is also known as Temporal Differencing is more prolific as it can easily adapt to changes in the background faster than the rest of the techniques. The cons of this approach are that the object under detection needs to in continuous moving state. This drawback is due to the reason that objects having uniformly distributed intensity values can be misinterpreted for their interior pixels as part of the background [5].

B. Result Of Frame Diffrencing Method

The result shows the Frame Differencing technique as efficient and highly low computational intensive method. In comparison to the more complex Gaussian methods (median and mixture) which are high computational methods, the frame differencing technique removes background noise more efficiently [5]. The main obstacle that this method poses is how to determine an appropriate threshold value.

a) Current Frame

b) Difference Frame

II. ROBUST ALGORITHM

This section deals with the procedure of detecting moving objects from the input image. The procedure comprises of the extraction stage and the grouping stage which are described as follows.

A. Extraction of Moving Objects

Background Modelling technique is used to extract moving regions from sequential images. The gray-scale BM is used to attenuate the intensity of the image by the extracted result of regions in motion. The RGB colour model has less execution time so we do not require additional image transformation. However, it is a major disadvantage to be very sensitive to even minute changes. The parameter δ is proposed to overcome the sensitivity problem. The δ is the threshold value which is calculated as following [4]:

$$\delta = u + 3\sigma$$

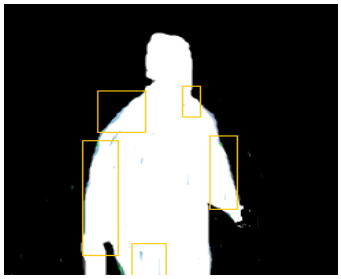
where, σ is the standard deviation of the difference image and u is the mean of the difference image. The pixels of moving object identify if there is a difference within the image in the image area. Using threshold technique, the object pixels get separated from background and once we get the background image, we then subtract it from current frame and if the difference is greater than threshold then the object is considered as a moving object [8].

One of the classical models used here is for detection of moving object is GMM [2]. This method can detect target in dynamic background, but the iterative operation of finding matched objects costs time and it tends to get disturbed easily by noise. The erosion operation of morphology performs the removal of the noises that are scattered irregularly, and the dilation operation of morphology helps to recover the loss of moving regions made in the process of erosion [3].

B. Grouping and tracking of moving object

A grouping scheme is applied in order to classify mobbing objects into several distinguishable groups before we perform the tracking of groups. The blob labelling is employed to group objects in motion which is shown in Fig. c, which is suitable for the real-time system because it is easily implemented and needs low computational cost [4]. The green boxes in Fig. d are the resulting groups of the blob-labelling.

c) Input Image



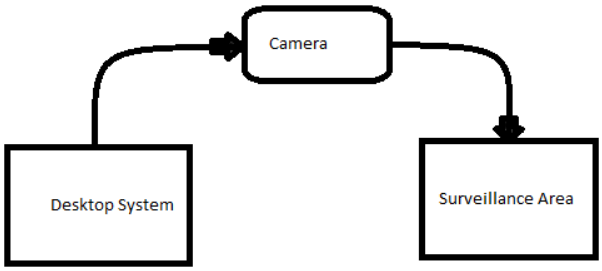
d) Result Image

The process involves the prediction of positioning of each group, identifying newly appearing and disappearing groups and recognizing the homogeneity of each group in the sequential frames. For extracting the moving target with exact size and also removing natural noises like shadow, lighting etc., the first step of improved algorithm is Gaussian blur filter [9] and the second step is to obtain the resulting image of moving area which is calculated by multiplying the differential adjacent two edge images with NOR operator [4].

The part of differential image in the area of moving edge of moving objects is mapped above the threshold value. Those parts are output immediately and they are connected to any part of strong responses [4], it will more likely to be actual moving target in the image.

IV. IMPLEMENTATION AND EXPERIMENT

The proposed detecting tracking is implemented as shown in fig. e



e) Environmental Setup

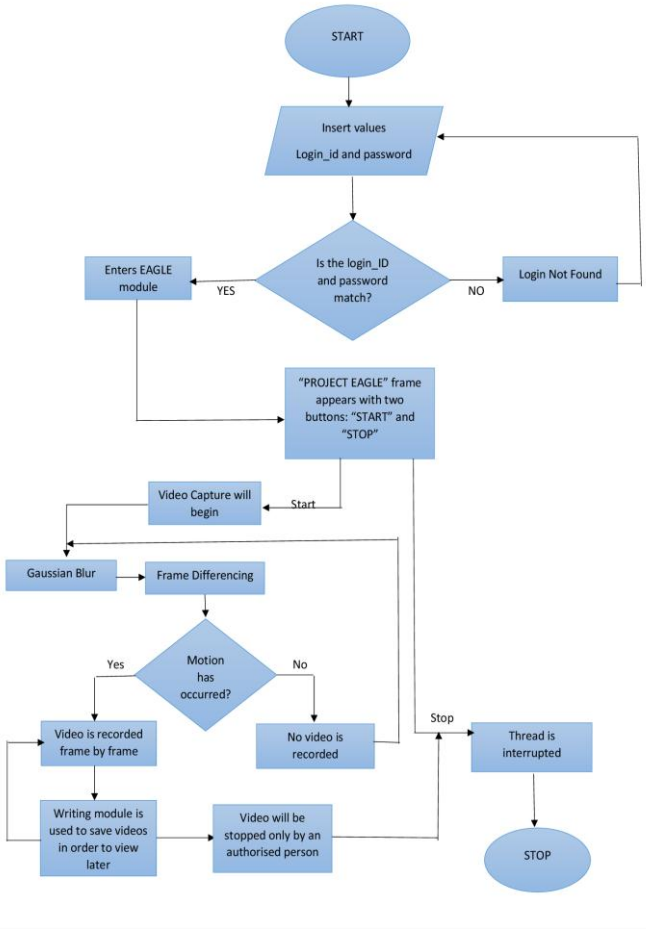
The surveillance area under monitoring is observed via camera which is connected to a desktop system, and the computer used is having the specifications of 1.9 GHz CPU and with 4 GB RAM, necessity for the image signal processing and proposed algorithm. The external device is used as per requirement of organization. In our case 1TB of external memory (HDD) is used. The video is sampled at the resolution of 320 x 240 pixels. The rate at which the video is captured is 30 frames per second. The location or area where the camera needs to be installed should be in an appropriate position where it is not visible to the usual customers but can be completely monitored by the owner or the Administrator.

The library which we have used in our project to implement the algorithms is OpenCV. The whole project is made by using Java language and the database used is Oracle 10g express edition to create the database of authorised user who will do surveillance. The proposed method consists of two parts one for detecting the moving objects and the other for tracking them. First is the "Background Subtraction Algorithm" which successfully implements frame differencing and removing foreground image from background image (frame by frame), and the background subtraction algorithm is wrapped with robust algorithm for moving objects. This algorithm successfully implements the grouping of objects and extraction of moving objects. With the use of Gaussian blur algorithm smoothening of image is performed [9]. The elimination of noises by morphology, and grouping the objects is done by using blob-labelling as shown earlier. The algorithms which we have used in our project are able to remove shadows in strong light as well as in weak light. The shape of moving objects and shadows in resultant image are much smaller than that in the original image, the algorithm can also extract the moving objects exactly.

The recording procedure discards the instance of time where motion is not occurring and when the motion occurs the video gets recorded and saved with corresponding time and date.

A. System Implementation

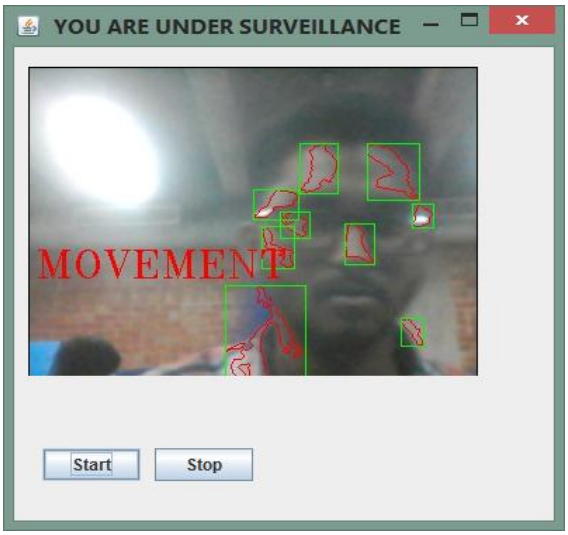
In Fig. f, we have shown the control flow of our project "Smart Surveillance System" where different modules have been integrated and their functions are described. After summation of various algorithms, the output of the project is accurate.



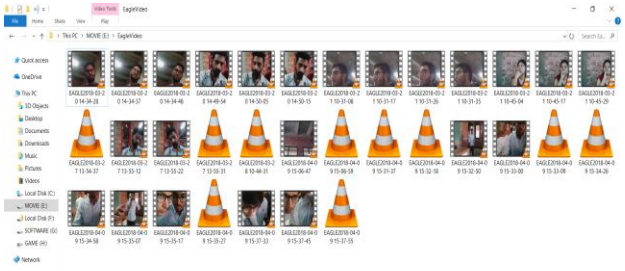
f) Flow chart of Smart Surveillance System

V. EXPERIMENTAL RESULT AND DISCUSSION

From the experiment, we have obtained the results that have been displayed in the following figures. Fig. g shows GUI where the detection of the group of moving objects is shown in green boxes and the red pattern shows the frame differencing. Fig. h shows the folder in which the videos are saved for later viewing. The videos that are getting saved are correctly being split along with date and time format in the desired folder. The results of the Gaussian blur algorithm are that videos get smoothened and the noises such as shadow and lighting are removed.



g) GUI



h) Destination folder

VI. CONCLUSION AND FUTURE SCOPE

In this paper, we have implemented Background Subtraction Algorithm along with Robust Algorithm for motion detection. This method is easy and effective. The noises and other natural phenomenon like shadow, lighting etc. will not bother us. The proposed method easily detects and removes such noises. The state-of-the-art of existing methods in each key issue is described with the focus on the following tasks: detection, tracking, personal identification for visual surveillance, and interactive surveillance using camera. Therefore, this kind of real time surveillance system has great prospect in building a secure digital world. The future scope of this project can be levelled to understanding of human behavior, which means that the action performed by the object is judged as right or wrong in respect with humane situations. This involves further research in machine learning.

VII. ACKNOWLEDGMENT

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Authors Profile

Yash Gupta is a student pursuing Bachelor of Technology (2014-2018) in Department of Computer Science and Engineering, PSIT College of Engineering, Kanpur. The contribution in the paper is study of robust algorithm for motion detection in order to determine the most effective method which can be applied to the project.

Samriddhi Mishra is a student pursuing Bachelor of Technology (2014-2018) in Department of Computer Science and Engineering, PSIT College of Engineering, Kanpur. The contribution in the paper is study of background subtraction algorithm in order to determine the most effective method which can be applied to the project.

Deepti Sharma is an Assistant Professor in Department of Computer Science and Engineering, PSIT College of Engineering. She guides students for better work and motivates them constantly. She has got her Masters of Technology Degree in Software Engineering from Naraina Vidya Peeth Engineering and management Institute affiliated with AKTU. She has 8 years of experience in teaching and her research interests include Digital Image Processing and Software Engineering. She has published a journal on the topic "Automatically Detection of Skin Cancer by Classification of Neural Network" in International Journal of Engineering and Technical Research (IJETR), January 2016.

