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RESEARCH ARTICLE

CAMSHIFT TRACKING FOR SURVEILLANCE APPLICATION

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ABSTRACT

The aim of this system is to track person of interest in real time based on scenes obtained from camera modules. This system avoids potential human errors as we are using automatic monitoring. It is a histogram based real time tracking system. Moving objects are detected using background subtraction. Moving object detection, recognition and tracking are basic steps in processing video frames.

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INTRODUCTION

Public security has become very important issue due to the increased terrorist attacks, burglaries etc. Electronic surveillance forms an integral part of today's security systems. CCTV modules are sold in huge numbers across the globe. Primitive surveillance systems (Raty, 2010) involved cameras. All these cameras would feed the live video to a dedicated monitor and in a control room many such monitors would be stacked one upon the other. These systems can be found in departmental stores, museum to high security areas like railway stations, airports and banks. The main objective of this project is to develop a system which reliably detects the person's presence or absence in a locality.The first part of the paper provides information about the algorithm selection and camera selection.

Literature review

In (Wang *et al.,* 2009) a method to track any object which is differ from the background was proposed. Multiple objects gets consistently tagged and hence it is a problem for selecting an object of interest. In (Sahani *et al.,* 2011) a method of tracking an aerial objects was discussed. The given image is divided into blocks and these blocks are adaptively changing their size according to template size.

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In (Jung *et al.,* 2006; Denman *et al.,* 2009) authors has discussed motion segmentation computation and also optical flow. It creates a difficulty when object is detected at start. In (Chen *et al.,* 2012) a real time tracking and adaptive framework was done. In (Cho *et al.,* 2006) partial filtering was discussed. In (Li *et al.,* 2009) author discussed mean shift algorithm which is suitable for multiple objects tracking. In (Cho *et al.,* 2006) it showed that these algorithms are computationally complex. In (Bradski *et al.,* 1998) CAM shift algorithm was discussed which simple and efficient algorithm for tracking. In (Qin-lan, 2009) location of the object could be tracked from probability distribution of an image. In (Gang *et al.,* 2010) the author proposed an algorithm which processes all the pixels in a given frame.

Video processing elements

- Methods for noise reduction

Noise is unwanted signal in a video capture which degrades the video quality. To reduce the effects of noise in the video capture, the following methods will be useful:

- Using low pass filtering method: Noise may creates sharp variations in image. Some part of image gets change due to noise. So low pass filtering can beuseful.
- Using averaging method: In this method of noise reduction 3 or 4 consecutive frames of videos are taken

and added pixel by pixel and then averaged. This will reduce the random noise.

Figure 1. Applications of camera surveillance systems

- **Color space conversion**

Camera modules provide the video in any color format. System converts the video from one color format to another. In image pipeline YUV color space is typically used. Taking human perception into account it encodes the color format. RGB color space is also simple to understand and it has all possible colors. It is made up of three colorants red color, green color and blue color.

System architecture

The application scenario would include an enclosed building where people enter one at a time. The building is equipped with many interconnected camera modules. Each of the entrances is to be provided with a camera system such that each entrant is registered by taking his high resolution photograph. These images of people are stored in a central storage. Whenever a query for a person is requested in terms of photograph, the supplied image is compared with the ones in the database. After verifying the person's presence, the feature related data of the subject is communicated to all the camera modules for tracking. The status of the tracked person is conveyed to the security official via a display terminal as shown in Figure1

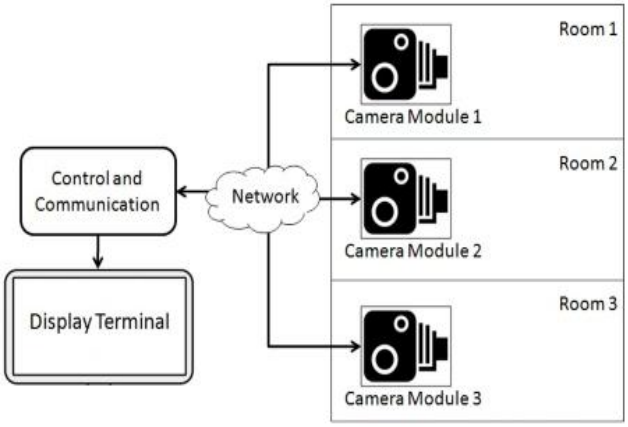

Figure 2. Block Diagram

Camera modules

The camera modules are located at various locations in an enclosed place or a building. As a high resolution image would require larger computations while a low resolution image would degrade the video quality. Hence, an optimum resolution of 640x480 is a good trade off. The camera must present the data in an easily readable RGB for further processing on the host machine.

Proposed tracking algorithm

The objective of this system is to track the moving person across multiple cameras. Algorithms for example particle filter and mean shift are used for tracking. Particle filter is difficult to implement in real time. Mean shift algorithm is less complex and required few computations to implement in real time. As the system needs to be real time mean shift algorithm is suitable. The limitation of mean shift algorithm is that it cannot detect change in size and orientation of objects. This can be solved by using adaptive mean shift algorithm. If the object is occluded then mean-shift algorithm failed. This can also be addressed by adding background subtraction into mean-shift algorithm. For using mean-shift algorithm for tracking the color information is required. This color information is known as histogram.

Division of image into blocks

To reduce the amount of computations, the frame is divided into certain number of blocks. The size of a single block is limited by the following constraints. It cannot be so large that the object size is in significant. It cannot be so small that the computational overhead exceeds the per pixel computations For optimum performance, block size should be equal to the size of the object when the object is at the farthest end from the camera, where it can be practically tracked. Thus the block size is chosen depending upon the size of the object and its distance from the camera.

Modified CAMshift tracking algorithm

Consider an image I, the input frame in which the object is to be searched and tracked. Let TRGB represent the object image, that needs to be searched. Each pixel in the image IRGB is indexed as (x; y). As discussed in previous sections, processing needs to be done only on H image for color targets and V images for grayscale targets. For a color target, let T and I represent the H planes while for grayscale targets, T and I represent V planes.

Background Subtraction (BGS): BGS is used to remove the effect of static background objects while tracking. This is the first step in the algorithm, where each camera module captures an image in the absence of the object to be tracked. This image forms the reference, That is subtracted from every subsequent frame. The subtraction is done only for H plane in case of color targets and V plane in case of grayscale targets. If B is the reference background frame and I is the newly acquired frame, then the difference image D is given as follows

Histogram

An image histogram is a graphical representation of the color distribution in image. It plots the number of pixels for each color intensity. By looking at the histogram for specific image a viewer will be able to judge the entire distribution at a glance.

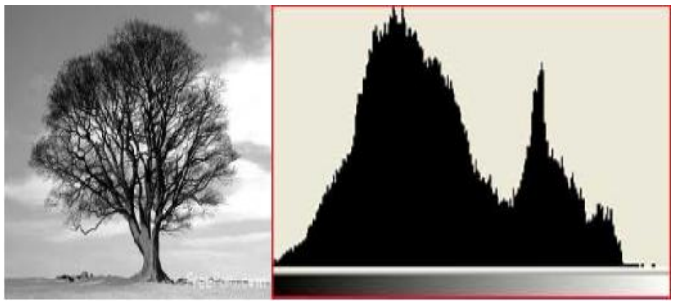

Figure 3. Image and it's histogram

Mean-shift algorithm

Mean shift algorithm is used for pointing the maxima of a density function. Hence the mean shift vector always point toward the direction where there is maximum density or where the gradient of density function is zero.

Adaptive mean shift algorithm

The performance of mean shift tracking is reduces in real time tracking as it uses fix window size. As the name indicates adaptive mean-shift algorithm uses adaptive window sizes. The window size changes depending on the features matching. This algorithm uses mean shift algorithm.

Conclusion

In this paper, we have presented new intelligent system for real time person tracking and described how the system can be used to track down person in a locality. The system is designed to receive the data from camera modules. We have integrated mean-shift algorithm to achieve adaptive window size.

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