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A Review on Motion Detection Techniques

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ABSTRACT

Motion detection is the process of detecting moving objects in background images. Motion detection plays a fundamental role in any object tracking or video surveillance algorithm. The reliability with which potential foreground objects in movement can be identified, directly impacts on the efficiency and performance level achievable by subsequent processing stages of tracking or object recognition. The system automatically performs a task and gives alert to security in an area. This paper represents review on Motion detection is an essential for many video applications such as video surveillance, military reconnaissance, and robotics. Most of these applications demand low power consumption, compact and lightweight design, and high speed computation platform for processing image data in real time.

Keyword: Video surveillance, FPGA (Field Programmable Gate Array), Motion detection, reference background frame, current frame

I. INTRODUCTION

Motion detection is the process of detecting a change in the position of an object relative to its surroundings or a change in the surroundings relative to an object. Video surveillance is a key technology for fight against terrorism, crime, public safety [3]. Video surveillance system for motion detection is a security device that is installed in building to detect unauthorized movement in restricted area [2]. Motion can be detected by measuring the change in speed or vector of an object. The making of video surveillance systems "smart" requires fast, reliable and robust algorithm for moving object detection and tracking [11].

Computer Vision offers powerful tools to extract meaningful data from complex images.

However, Computer Vision algorithms are often encumbered by high computational complexity, poor scalability, and the need for preprocessing [10]. It plays very important role in the realization of a complete vision based automated video surveillance system for automatic scene analysis, monitoring and generation of security alerts based on relevant motion in a video scene, such as human detection, vehicles detection, threat, security [13]. Motion detection in a video scene provides significant and important information related to movement and presence of objects in a scene. This information helps in achieving motion detection. Motion detection is used as security system in banks, offices, shopping mall and also as intruder alarm in home [17]. Various motion detection methods have been extensively investigated in the literature.

Now-a-days, closed circuit television (CCTV) camera based surveillance for security has been widely used in the entire world. Today with the development in technology, security and safety are major concerns. To address this concern, the number of surveillance cameras has increased in recent past [4]. Data collected is nevertheless difficult to store and monitor manually on a continual basis. The CCTV cameras are generating huge amount of data. The security system requires large storage and faster processing capabilities [15]. Developing the system for object detection creates nonlinear scenarios between data size and processing time. Algorithm complexities irrespective of high configuration and high requirements are the basic problems associated with

the idea. The scenarios are different where motion can be detected [5]. Firstly, recording only when motion is detected or also taking continuous inputs from video devices and another one is suspicious activity detection based on moving objects in the image frame are the main targets considered in this review [8]. 2

II. LITERATURE SURVEY

Since multimedia application are happens to be required and emerging in current scenario and consequently motion detection is one of the event in the multimedia application where major focus needs to give, hence comprehensive of review here is presented. Respective literature survey is done by considering applicability's of motion detection.

In motion detection, background subtraction is simplest method, so many authors have tried to implement. Following are the few literatures explaining the background subtraction algorithm. Birmohan Singh et al. [2013] [3] presented a moving object detection system using a background subtraction technique. Above mentioned software based system uses frame differencing method along with proper selection of step length. Threshold algorithm is used for object detection. Threshold algorithm is set to particular value to decide whether object is moving or steady which results in moving object detection. S´anchez-Ferreira et al. [2012] [1] proposes a moving object motion detection system based on background subtraction algorithm and developed on DE2 development kit over an Altera platform based on a Cyclone II EP2C35 device. Proposed method uses the subtraction method along with low pass filter using 3*3 mean filter. Segmentation, erosion and convolution filter has been used for eliminating noise and making image sharpen. This image processing method gives noiseless and error free image. This method gives faster result than previous method by factor of 32 in terms of computation time. Shreekant Sajjanar et al. [2016] [4] implemented the real time moving object detection using FPGA. The system has been developed on Zynq XC7Z020 board using modified background subtraction algorithm. Proposed method gives results in terms of '1's and '0's. '1' shows white as background and '0' as detected object. The system as in above is optimized system in terms of speed, performance which has shown that FPGA is 100% faster than software simulation owning to the parallelism. Chopkar et al. [2016] [11] developed an algorithm to detect moving objects based on background subtraction and implemented it on FPGA. Olugboja et al. [2016] [5] have developed moving object detection system using Gaussian Mixture Model (GMM) and morphological filters. Above mentioned software based method uses background subtraction using GMM. GMM and threshold method is used for detecting the moving object. Smoothening and morphological filtering is used for noise removal in output image. Finally, vision blobs algorithm has been applied to output image in which blobs less than the number of pixels specified will be removed and only object is detected. Reddy et al. [2013] [10] developed a human motion detection system on a Xilinx Spartan 3 FPGA device using and embedded development kit (EDK) from Xilinx. Moving objects and its background has been found out by threshold technique. Projection and shape analysis is used for detecting the human in moving objects. Tairi et al. [2015] [14] presented Motion detection based on the combining the methods of the Background Subtraction and the Structure-Texture Decomposition (BS-STD). Structure component from each of the image sequence has been extracted with the help of Osher and Vese technique. By using Otsu's method, binary image of moving objects has computed. Otsu's method is self-adaptive method of threshold method which is used for segmentation. This software based simulation has shown effectiveness and accuracy for object detection.

As per review from above article, software based algorithm are simple but cannot give satisfactory results so system can be implemented on parallel processor for faster result. The background subtraction algorithm can be used only when background of image is known. This is the drawback of using background subtraction algorithm.

Menezes et al. [2010] [2] developed FPGA based hardware for motion detection of vehicles on transit road. Experimental result shows that hardware based system performs 7.5 times faster than normal software based approaches. Software based approach takes more processing time than the hardware based approach. So the software based methods are time consuming. On the basis of this paper, it is clear that FPGA based hardware system is advantageous over the software based systems. This indicates that processing time of image in hardware kit is less as compared to the images processed in software platform. However in future, motion detection system including both hardware and software platform should be developed. The processing time of image and speed of motion detection in this system should be tested.

Zhai et al. [2013] [6] developed a GMM model based on color and neighborhood pixels feature information.

Firstly, by the use of pixel color information, initial GMM model has been designed and obtained 3 parameters of GMM model. Then the gradient and modified local binary pattern (LBP) feature has been extracted and a new GMM has been developed to get accurate results. In this method, a unique voting strategy has been used during the foreground pixel detection. If a pixel has detected out as foreground then the pixel has been added into the GMM model with a very low weight and learning rate. The foreground or background image has been extracted using the Gaussian cells of pixels and also pixels around it. M. Sahasri, C. Gireesh[2017] [16] has achieved a task of object detection by using background subtraction and foreground mask sampling. Proposed method uses a cascade classifier for object detection. Cascade classifier uses Haar basis function which is used to capture the intensity gradient at different locations, spatial frequencies and directions by changing the position, size, shape, and arrangement of rectangular regions exhaustively according to the base resolution of the detector.

From the above mentioned literature review, it is known that due to shape based structuring element used in the morphological operation reduces some of the image content. The main drawback of this method is large memory requirements. It can't be afforded because as memory requirements increases, computational time for processing an image also will be high. So as a future work, combination of GMM algorithm with different filtering techniques should be tested rather than morphological filtering in order to avoid data loss.

Zhang et al. [2017] [7] developed an algorithm for moving object detection in video sequences based on clustering. The high optical flow regions extracted using Simple flow algorithm and the clustering method is applied on the histogram of optical flow orientation. The clustering method is applied to segment moving objects which are close to each other along with threshold method. Accuracy and speed of motion detection is higher when clustering is used for image segmentation. From above discussed review, it is clear that in order to increase the speed of object motion detection, the clustering algorithm has to be incorporated into motion detection systems. Implementing this system with FPGA will give good performance.

Lazer et al. [2016] [8] developed the efficient local phase algorithm to detect the motion. It consists of two building blocks; first evaluates the temporal change of the local phase Fast Fourier Transform (FFT) based algorithm for implementing the change of the local phase and second processing building block implements the detector. This algorithm shows that locally detected motion can be used for segmenting moving objects in video scenes and compare local phase based algorithm to achieve segmentation with widely used optic flow algorithm. A temporal high pass filter is then employed to extract phase changes. Motion is detected for block with PMI (phase motion indicator) larger than a present threshold method. This algorithm can be highly parallelized. In above discussed method, phase based motion detection algorithm has efficiency on detecting local motion. This detected local motion can be used in motion segmentation task. The effectiveness of the segmentation is to compare segmentation using motion information obtained from optic flow based algorithm. The drawback of this flow algorithm is that it only detects motion locally and does not consider the overall shape of any objects. Proposed system should be implemented on hardware rather than software for accurate results.

S. Vishal et al. [2016] [9] presents video surveillance system that has ability to alert and record beside live video of intruder. This smart surveillance system is based on internet of things (IOT), the system will send notification when an intrusion is detected inside the room. The entire work is done on raspberry pi with Raspbian Operating System (linux) ported on it. Hardware module for proposed system consists of Passive infrared (PIR) sensor. PIR is used to detect the motion connecting with raspberry pi, which has Ethernet port used for sending message or alert of intrusion connecting to android device. In android device, user can view the captured images remotely and also receive the notification message. Above mentioned system is efficient and gives better performance. Power consumption is high in raspberry pi as compare to other hardware. In future, the system can be made of rechargeable battery for supply and also for less power consumption; the system should be implemented on alternative hardware.

Kumar et al. [2015] [12] created a Simulink model for object tracking using optical Flow. The tracking of the object is based on optical flow. In this paper, a combined motion segmentation algorithm for object tracking has been used. Optical flow techniques are prone to errors caused by changing lightning and occlusions, both common in surveillance environment. Optical flow algorithm along with threshold technique and region filtering is used for 4 object tracking. But objects with erroneous motion in background regions can be reduced using mean shift algorithm. The optical flow method has a few

disadvantages like a large quantity of calculations, sensitive to noise and poor anti-noise performance. So the optical flow method is not appropriate for real-time object detection and tracking. Simulink model for object tracking can be implemented on reconfigurable platform which can able to give better performance than Matlab.

Cheng et al. [2012] [13] proposed a pyramidal background modeling structure for motion detection. The method uses the spatial, spectral and temporal characteristics of images (obtained from video sequence) to generate a pyramidal structure of the background model. By using rough matching algorithm, the block candidate of each of the incoming frame has been calculated. With the aid of precise adaptive procedure, the characteristic of temporal activity of the pixels within each block candidate has been extracted out and the best background has been selected by the precise matching procedure. Then the absolute difference between the current frame and the background frame has computed. The noise in the difference image has been reduced by the Bezier Curve Smoothing method. Finally, moving object detection mask of the video sequence frames has been computed by the threshold which has been calculated based on Probability Mass Function (PMF) and Commutative Distribution Function (CDF). In future, complexity of motion detection system can be minimized by either using pixel based or block based background modeling.

Mandeep Kaur et al. [2017] [15] presented the comparison of local binary pattern with normal subtraction method for motion detection. Local Binary Pattern (LBP) is used to examine the difference in the frames to detect the minimal motions of required object. In LBP, feature matching algorithm has been used in which the frame window is divided into number of blocks; mainly 3*3 block size is used. LBP method is used to calculate the bit-by-bit movement i.e. minor implementation rather than the byte movements. LBP will form the pattern in the form of binary values through the use of neighbor pixels. By applying LBP algorithm, the comparison has been done with current and reference frame. This technique will help to detect minor movements of object. The proposed technique can be used in the future by enhancing different regions in LBP which may improve the detection performance and accuracy of design system.

Rushambwa et al. [2016] [17] developed and explained Real Time Wireless Surveillance System with Motion Detection with the aid of the Internet. The system consists of D- link dcs 930 camera with inbuilt wi-fi and internet services, microcontroller and PIR motion sensor. Wireless camera is connected over internet and captures images when motion is detected. Only authenticated person can access the system to active and deactivate the system. The system discussed above is highly secured. When motion is detected, an event is triggered that sends images captured by the camera to the owner's email address and also sends notification SMS to the owner. Microcontroller is easy to interface with Ethernet which is used to control the devices over internet. Device includes camera and motion sensor. Due to system complexity trained person needs for installation. There is need of alternative hardware which gives parallel image processing for less complexity.

III. CONCLUSION

This review paper gives brief survey on various motion detection techniques. The basic motion detection methods are background subtraction, optical flow and clustering. Most of the researchers prefer to use background subtraction because of its simplicity. In the optical flow technique of motion detection is time consuming and computationally complex. Also optical flow method has high specialized hardware requirements and so this method cannot be used in real time motion detection system implementation. From the literature review it can be concluded that there is prerequisite to implement image processing technique on FPGA in order to achieve motion detection with accuracy and speed. So in order to develop precious and optimize system, motion detection and background subtraction system is preferable.

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