Real Time Detection of Moving Object Based on Fpga

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Abstract: *Moving object detection and tracking algorithm is become very popular now days and one of the current challenging research topics in various field, such as intelligent airport security system, transportation system, military security, identification of person, anomalous behavior detection, computer vision, video surveillance applications, and so on. As well as it become key technology to fight against terrorism, crime, public safety and for efficient management of traffic. Fast and reliable algorithms are required for making the video surveillance systems smart. In this work the object detection algorithm implementation can be employed in real time systems. And new method is use to detect moving object which is based on background subtraction method and its FPGA implementation in surveillance video applications. In this method, we used static camera for capturing video and first frame of video is directly consider as reference background frame and this reference background frame is subtract from current frame to detect moving object. Reference background frame is the first frame and current frame is the frame under processing. The background subtraction algorithm implementation is done in two domains, code is written in MATLAB then using simulation.*
Keywords: *FPGA, Moving Object Detection, Static Camera, Reference Background, Current frame, MATLAB.*

I.   Introduction

Now days for monitoring the security sensitive areas such as banks, department stores, highways, crowded public places and borders Video surveillance has long been in use. As well as it become vast research field concerning the automatic analysis of images and image sequences, with a broad spectrum of applications like remote sensing, medical diagnosis, human-computer interaction or video compression etc. After the attacks on the 11th of September 2001 in New York, 11th of March 2004 in Madrid and 7th and 21st of July 2005 in London, video surveillance systems have experienced a rapid development in the last decades, especially leading them to become a part of our daily life. Detection and Tracking of moving objects is one of the most important task and an essential processing component in mobile robotics, video surveillance applications, path planning and various field. For achieving an alternative design for rapid development that allows real time motion detection systems, this paper proposes architecture for motion detection based on the background subtraction algorithm, and its implementation on FPGAs (Field Programmable Gate Arrays).For real time video processing applications Field programmable gate arrays (FPGA) technology become an effective option. Particularly, efficient FPGA implementation of moving object detection algorithms can offer significant benefits in future design within the computer vision field and video surveillance. The aim of moving object detection is extracting objects which are moving in that video sequences with background [1]. For detection of object in the image the background subtraction algorithm is used. The subtraction of the image is pixel based subtraction.There are basically three ways for detection of motion in image sequences: (a) temporal difference, (b) Optical flow and (c) background subtraction. And each one has its own advantages and disadvantages. Optical flow method is good when there is moving camera so it is difficult to meet the requirements of real-time video processing. In temporal differencing method adjacent frames are used for subtraction and get difference images which is depend on time sequence [2]. In this paper we use background subtraction method. This method is advantageous over the optical flow method and temporal differencing method. In background subtraction method first video is capture from static camera and converts that capture video into the frames and then that frames in to images. Consider first frame as reference background frame and next one is the current frame. Reference background frame is the first frame and current frame is the frame under processing. Apply subtraction operation and compare it with to the certain threshold values. If the pixel difference is greater than the set threshold value T, then it determines that the pixels from the moving object, otherwise, as the background pixels. If we compared above three methods, background subtraction is the real-time and accurate method for moving object detection and Tracking. This method use dynamic threshold method to obtain a more complete moving object and can effectively eliminate the impact of light changes. The main advantages of this algorithm are, it is very fast and uncomplicated, able to detect moving object better with broad applicability. It has great reliable and mostly used in video surveillance applications. This method is simple, easy to realize as well as accurately extracts the characteristics of target data [3].

This paper is organized as follows in the section I introduction to object detection in video surveillance in the section II Literature Review after that in section III System design in section IV background subtraction. In section V Experiment result and in section VI conclusion and Future scope discuss.

II.   Literature Review

In modern computer vision the detection of moving object is one of the most important areas of research. Recently in moving object detection various investigations and analyses has been done. In most of the vision application, detection of moving objects plays very important role for processing the video. The vision systems include image processing methods which are widely implemented in many areas as traffic control, video surveillance of unattended outdoor environments, video surveillance of objects etc. This project describes the FPGA implementation of a background image subtraction method for real time detection of a moving object in surveillance video applications. The purpose of background subtraction method is to "remove" the background from the moving object video describing an efficient model of the background.

Mr. Mahesh C. Pawaskar el.al , describe three sequences in "Detection Of Moving Object Based On Background Subtraction", that three different sequences are, sequence hall monitor, sequence water surface, sequence moving curtains that represent typical situations which is critical forvideo surveillance systems, and present qualitative results obtained with the background subtraction method [4]. Anu Susan Philip stated in "Background Subtraction Algorithm for Moving Object Detection Using Denoising Architecture in FPGA", moving object motion detection system based on background subtraction algorithm was developed in that system works on a real-time pipelined flow. Also by extracting its shape and calculating the gravity center, the system detects an object [5].

A. Talukder, S. Goldberg, L. Matthies, A. Ansar stated that multiple object which are moving detected by the real time algorithm that moving object as a robot undergoes egomotion. This technique does not require any knowledge about robot egomotion and even it handles camera robot vibrations on uneven surfaces. Therefore for making the solution very general and applicable to various dynamic perception problems this technique represents a clear improvement to traditional dynamic perception procedures [6].In Detection and Tracking of Very Small Low Contrast Objects D. Davies, P. Palmer, & M. Mirmehdi used an algorithm which apply on a sequence of FLIR images taken by a fixed sensor. In the sequence an aircraft is approaching and there is a road in the middledistance with cars travelling along the road. The main aim is to try and detect all these movingobjects and to track them at least long enough to determine whether their trajectories arehostile [7]. Basically there are three methods of object detection from moving object. (a)Temporal Difference (b) Optical Flow (c) Background Subtraction.

(a)   Temporal Difference or Frame Difference: -This method also called as frame difference method. This method is nearly similar to that of the background subtraction algorithm. In this method two or three adjacent frames are consider and apply subtraction operation in video sequences, if the difference in between the pixel values for a given pixel is greater than a set threshold value, then that pixel is considered as part of the foreground. This method is very simple and easy similar to background subtraction method. But sometime this method dose not finds out complete outline of the moving object so the detection of moving object is not accurate [8]. It generally fails to detect whole pixels of some types of moving objects. Also, this method fails to detect stopped objects in the scene. And we cannot use this method for real time without any specialized hardware.

(b)   Optical Flow: - The optical flow is a useful algorithm for the tracking of a moving object. This method is used to calculate the image optical flow field. Cluster processing is done according to the optical flow distribution features of image. This method detects the moving object from the background better than other methods and gives the complete movement information of the object. Because of the large calculation, sensitivity to noise and poor anti-noise performance and its high computational cost; this method is not suitable for real-time [9].

(c)   Background Subtraction: - This Technique is very commonly used for motion detection because of its simplicity. The Background Subtraction Algorithm is used to detect moving objects in video frames from a fixed camera. Pixel based subtraction is done in this method. In this method, we used static camera for capturing video and first frame of video is directly consider as reference background frame and this reference background frame is subtract from current frame to detect moving object. Reference background frame is the first frame and current frame is the frame under processing [10]. If the pixel difference is greater than the set threshold value T, then it determines that the pixels from the moving object, otherwise, as the background pixels. Here we consider first frame as the background frame directly and then that frame is subtracted from current frame to detect moving object.

III. System Design

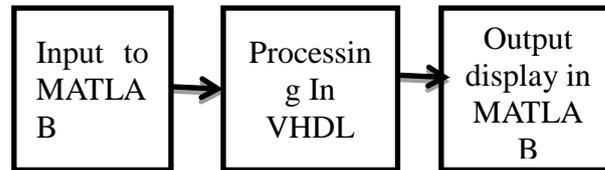| Input to MATLAB | → | Processing In VHDL | → | Output display in MATLAB |

Fig.1 System Design

Currently, both at the market and the academic communities have required applications which are based on image and video processing with some of the real-time application. On the other hand, in mobile robotics and surveillance applications detection of moving objects is a very important task. For achieving an alternative design that allows rapid development of real time motion detection systems, proposed architecture for motion detection which are based on the background subtraction algorithm.

VHDL stand for Very High Speed Integrated Circuit Hardware Description Language. It is a hardware description language used for modeling a digital system at many levels of abstraction, ranging from the algorithmic level to the gate level. VHDL is a hardware description language used in electronic design automation to describe digital and mixed-signal systems such as field-programmable gate arrays and integrated circuits. VHDL can also be used as a general purpose parallel programming language. The VHDL language has constructs that can express the concurrent or sequential behavior of a digital system. It also allows the system as an interconnection of components. Test waveforms can also be generated using the same constructs. It is not application language. It cannot directly process on video, so we are giving video input via MATLAB, so that it get converted from .avi(video format) in to the VHDL format. The VHDL code will perform background subtraction, object detection and tracking and creates the output file which will be given to the MATLAB for playing.

IV. Background Subtraction

The background subtraction is very popularly and commonly used method for the detection of motion. For detection of the motion difference between the current frame and the background frame are taken in this technology [11], and generally it is able to provide data with object information. The Background Subtraction Algorithm is used to detect moving objects in video frames from a fixed camera. The reference background frame is subtracted from the current frame. If pixels difference is greater than the threshold value T, then it determines that the pixels are from the moving object, otherwise, it is background pixels. Reference background frame is the first frame and current frame is the frame under processing.

By applying background subtraction algorithm we will get the background frame as $I_1(x, y)$ and a current frame as $I_2(x, y)$, then subtract the background image $I_1(x, y)$ from the current frame $I_2(x, y)$. If the pixel difference is greater than threshold value T, then it determines that the pixels from the moving object, otherwise, as the background pixels. This Technique is very commonly used for motion detection because of its simplicity.

$$D(X, Y) = \begin{cases} 1 & \text{if } |I_2(X,Y) - I_1(X,Y)| > T \\ 0 & \text{Others} \end{cases}$$

Where, Tis a threshold, which decides the pixel whether it is foreground or background. If the difference is greater than or equal to T, the pixel is consider as foreground; otherwise the pixel is as background.

V. Experimental Result

Automated surveillance systems have critical importance for the field like security, behavior detection, computer vision etc. Our work focusing on generation of frame and detect moving objects and generate reliable tracks from real-world surveillance video. Following figures shows results for moving object detection using Reference Background subtraction. Here we used static camera to capture video images. MATLAB is a simple an event driven simulation tool which provides a platform to analyze the static and dynamic nature of the video processing.
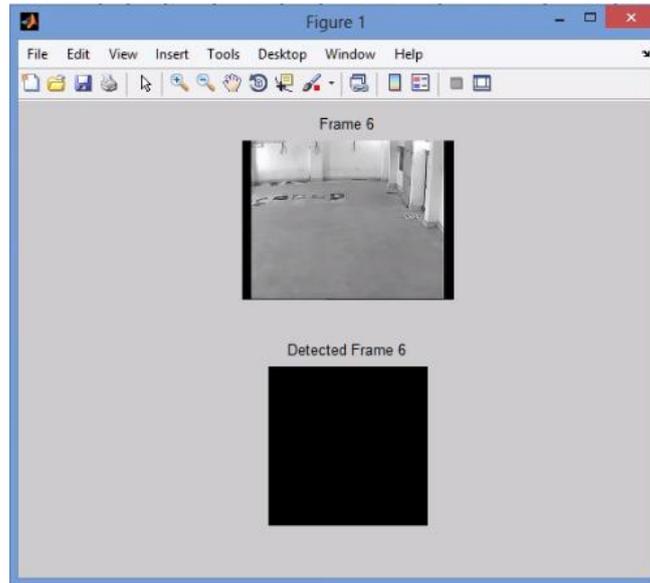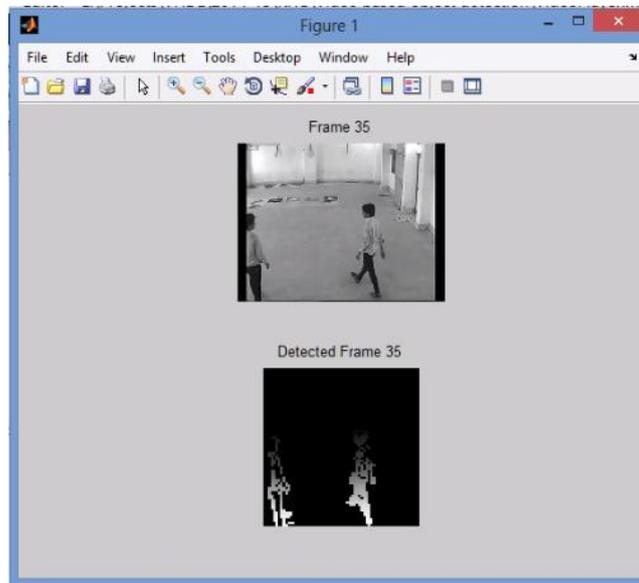
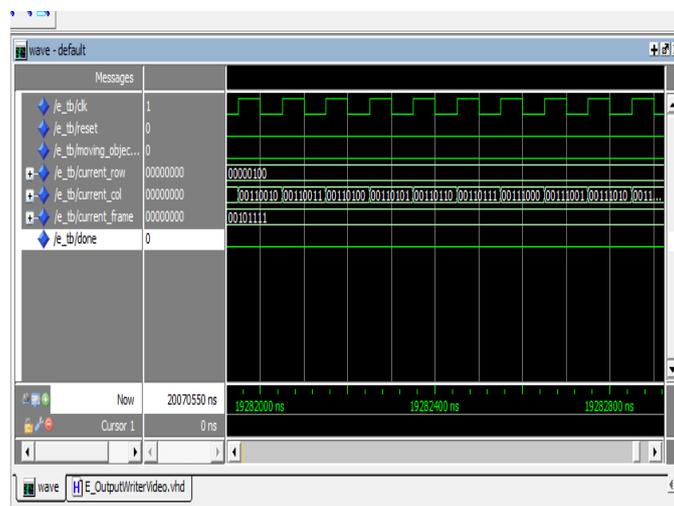Fig.2 Background Subtraction

Fig.3 Moving Object Detection

Fig.4 Simulation Result

VI. Conclusion And Future Scope

Object detection and tracking requires the use of an efficient signal processing system. A real-time detection method for moving object detection and Tracking proposed based on reference background subtraction. And this method use threshold value to obtain a more complete moving object. Here in this project, we present the background subtraction method for motion detection of object. Video processing is achievable on serial processors, it can be beneficial to take advantage of the, low cost, and low power consumption. We have demonstrated this by designing a simple video which contains an object in motion. It can handle object detection in indoor and outdoor environments, this algorithm is very fast and uncomplicated, able to detect moving object better and it has a broad applicability. This method is very reliable and mostly used in video surveillance applications.

In future work includes identification of the personal using face, palm recognition. Identify moving object when video captured by moving camera. Activity recognition is an important steps in visual surveillance system so that identify the behavior of the person can be done is our future task.

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