FPGA Implementation of Selective Eigen Background Using Background Subtraction Algorithm in Crowded Scenes

S.Soomiya Begum, K.Lokeswara Reddy

M.Tech VLSI System Design, A.I.T.S, Kadapa, Kadapa(D), India

Assistant Professor, A.I.T.S, Kadapa, kadapa(D), India

ABSTRACT: In this paper a new background subtraction algorithm was developed to detect moving objects from a stable system in which visual surveillance plays a major role. However background subtraction in crowded scenes remains challenging especially when a large number of foreground objects move slowly. Among all existing algorithms it was chosen because of low computational complexity which is the major parameter of time in VLSI. The concept of the background subtraction is to subtract the current image with respect to the reference image and compare it with to the certain threshold values. Here we have written the core processor Micro blaze is designed in VHDL (VHSIC hardware description language), implemented using XILINX ISE 8.1 Design suite the algorithm is written in system C Language and tested in SPARTAN-3 FPGA kit by interfacing a test circuit with the PC using the RS232 cable. The test results are seen to be satisfactory.

KEUWORDS: Background subtraction, selective Eigen back- Ground, virtual frames, selective model initialization, selective Reconstruction, Micro blaze, Spartan-3 fpga kit etc.

I. INTRODUCTION

Object detection and tracking is one the most important tasks in computer vision. In video surveillance, it assists understanding the movement patterns of people to uncover suspicious events. It is a key technology in traffic management to estimate flux and congestion statistics. Advanced vehicle control systems depend on the tracking information to keep the vehicle in lane and prevent from collisions. In physical therapy, analyzing the mobility of patients improves the accuracy of their diagnosis. Learning the shopping behavior of customers by tracking assists the architecture design in retail space instrumentation. In robotics, tracking bridges the gap between the raw visual information and environmental awareness. In video summarization, it is applied to generate object-based representations and automatic content annotations. Tracking is also a fundamental technology to extract regions of interest and video object layers as defined in JPEG-2000 and MPEG-4 standards. Even though it is essential to many applications, robust object tracking under uncontrolled conditions still poses a challenge . Real-life systems are required to track objects not only when the background scene is static but also when lighting changes suddenly, camera-object motion becomes large, color contrast becomes low, image noise soars to an unacceptable level, etc.In addition, the computational complexity is required to be kept minimum for real-time performance.

II. REVIEW OF PREVIOUS ALGORITHMS

This paper is organized as follows in the section I. introduction to object detection in video surveillance and in the section II. previous algorithms and disadvantages after that in section III.Proposed background modeling. IV.Experimental setup V.Results and finally VI.conclusion.

There are several approaches for moving detection task namely, (a) the optical flow Method (b) the temporal difference Method and (c) background subtraction.

A. Optical Flow Method

In a video frame, the field of motion vector per pixel or sub-pixel is called optical flow. There are many a methods for computing optical flow among which few are partial differential equation based methods, gradient consistency based methods and least squared methods. The objective in optic flow calculation is to find the 2D-motion field in an image sequence. As a pixel at location (x,y,t) with intensity $I(x,y,t)$ will have moved by $\delta x, \delta y$ and δt between the two frames the following image constraint equation can be given:
$I(x,y,t)=I(x+\Delta x,y+\Delta y,t+\Delta t)$

Assuming that the movement is small enough, the image constraint at $I(x, y, t)$ with Taylor series can be derived as
$I(x+\Delta x,y+\Delta y,t+\Delta t)=I(x,y,z)+\partial I/\partial x(\Delta x)+\partial I/\partial y(\Delta y)+ \qquad \partial I/\partial t(\Delta t)+HOT$
where H.O.T. means those higher order terms, which are large enough to be ignored.
From these equations follows that

$$\Delta x +\Delta y+\Delta t=0$$
or
$$\frac{\partial I}{\partial x}\frac{\Delta x}{\Delta t} + \frac{\partial I}{\partial y}\frac{\Delta y}{\Delta t} + \frac{\partial I}{\partial t}\frac{\Delta t}{\Delta t} = 0$$
Which results in
$$\frac{\partial I}{\partial x}V_x + \frac{\partial I}{\partial y}V_y + \frac{\partial I}{\partial t} = 0$$
The main disadvantage of this Optical flow approach is hard to a apply in real-time due to its high computational cost.

III. REVIEW OF PREVIOUS ALGORITHMS

B. Temporal Difference Method

The Frame difference is arguably the simplest form of background subtraction. The current frame is simply subtracted from the previous frame, and if the difference in pixel values for a given pixel is greater than a threshold (Th), the pixel is considered part of the foreground. A major flaw of this method is that for objects with uniformly distributed intensity values (such as the side of a car), the interior pixels are interpreted as part of the background. Another problem is that objects must be continuously moving. Let F_{i-1} be the previous frame and F_i be the consecutive frame, where i= 1 to n. The pseudopodia is given below:

For(i=1; i<n; i++)
{
If (Fi-1 - Fi) > Th
Then accept and process the frame
Else
Reject the frame
}
Where 'Th' is called as Threshold value. Temporal differencing is very adaptive to dynamic environments, but generally does a poor job of extracting all relevant feature pixels. Due to the disadvantages of this two algorithms we go for background subtraction algorithm.

IV. PROPOSED BACKGROUND MODELING

Background subtraction is a commonly used class of techniques for segmenting out objects of interest in a scene for applications such as surveillance. It compares an observed image with an estimate of the image if it contained no objects of interest. The areas of the image plane where there is a significant difference between the observed and estimated images indicate the location of the objects of interest. The name "background subtraction" comes from the simple technique of subtracting the observed image from the estimated image using basic thresholding process.

A. Selective Eigen Background method

The main objective of this work is to present an effective Eigen background method that can keep robust in crowded scenes..our method exploits these "selective" mechanisms for background modeling and subtraction, including automatically constructing virtual frames as the training and update samples Eigen backgrounds called selective training, adapting choosing the optical background model for initialization called selective model initialization and Selecting the best Eigen background. For each pixel to reconstruct its background pixel(called pixel-level reconstruction)using thresholding mechanisms our method can significantly increase the purity of the trained Eigen background and obtain an improved quality of reconstructed background image.

$Moving(i; j) = | Foreground(i; j) - Background(i; j)|$

When the difference value is greater than the threshold value it is considered as a foreground otherwise it is background object.
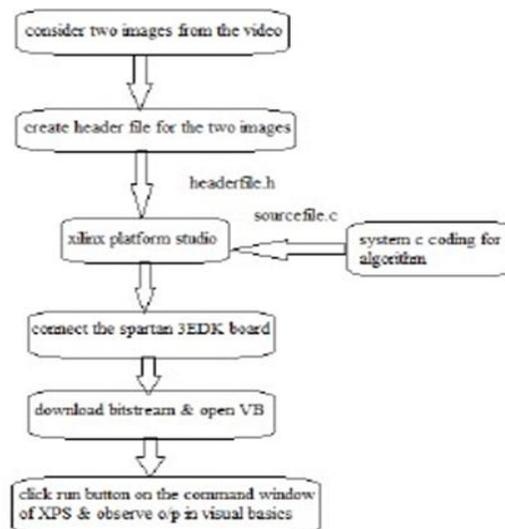
Fig 1: Flow diagram for proposed algorithm

In the first step we consider the video and convert it into frames, from that frames we can select any of two images for that two images we create a header file .And then we can write an algorithm for back ground subtraction in the XPS tool by using system 'C' language. In the XPS we are giving two inputs of header file.h and source file.c. XPS is a tool used to link a program to hardware like FPGA. After downloading the bit stream open the visual basics application and click run button on the command window of XPS .Finally with the help of UART port and RS232 cable we made a communication between hard ware and our PC and we can see the output
image in the PC with the help of visual basic tool.

V.EXPERIMENTAL SETUP

A. Xilinx Platform Studio

The Xilinx Platform Studio (XPS) is the development Environment or GUI used for designing the hardware portion of your embedded processor system. Xilinx Embedded Development Kit (EDK) is an integrated software tool suite for developing embedded systems with Xilinx Micro Blaze and PowerPC CPUs. System design consists of the creation of the hardware and software components of the embedded processor system and the creation of a verification component is optional. A typical embedded system design project involves: hardware platform creation, hardware platform verification (simulation), software platform creation, software application creation, and software verification. Base System Builder is the wizard that is used to automatically generate a hardware platform according to the user specifications that is defamed by the MHS (Microprocessor Hardware Specification) file. The MHS file defines the system architecture, peripherals and embedded processors]. The Platform Generation tool creates the hardware platform using the MHS file as input. The software platform is defined by MSS (Microprocessor Software Specification) file which defines customizing operating systems (OS), libraries, and drivers and the the User Constraints File (UCF) specifies timing and placement constraints for the
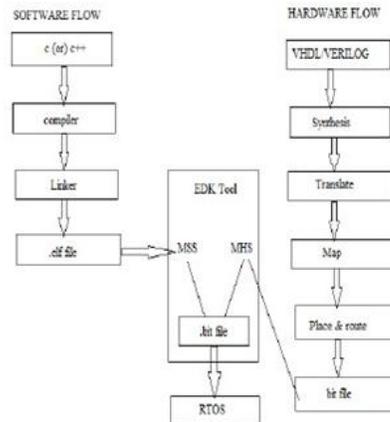
FPGA Design

Fig 2 : Embedded Development Kit Design Flow

B. Downloading bit stream to FPGA

When you select Device Configuration in that Download Bit stream, XPS downloads the bit stream (download.bit file) onto the target board using impact in batch mode. XPS uses the file etc/download.cmd for downloading the bit stream.
Because XPS tools are make file based, the download button calls on the make file and executes the steps necessary to create the bit stream with the ELF file populated within the bit stream.

C. visual basics

The VB programming system packages up the complexity of windows in a truly amazing way. It provides simplicity and ease of use without sacrificing performance or the graphical features that make window such a pleasant environment to work in Menus, fonts, dialog, boxes etc are easily designed and these features require no more than a few lines of programming to control. It is one of the first languages to support event driven programming a style of program especially suited to graphical user interface. The aim in modern computer application is to have the user in charge. Instead of writing a program that plots out every step in precise order, the programmer writes a program that responds the users action like

choosing a command, moving the mouse etc. Instead of writing on large program, the programmer creates an application, which is a collection of co-operating many programs. This project has been done with a virtual view of the traction of the train. It represents the animated view of the moving train with boogies with the multimedia effects etc. The features of the visual basics are improved performance, Visual data access with the data control so that it is possible to create data browsing application without writing code. A new OLE (object linking and embedding) control and a collection of common dialog boxes that streamline common user interface tasks.
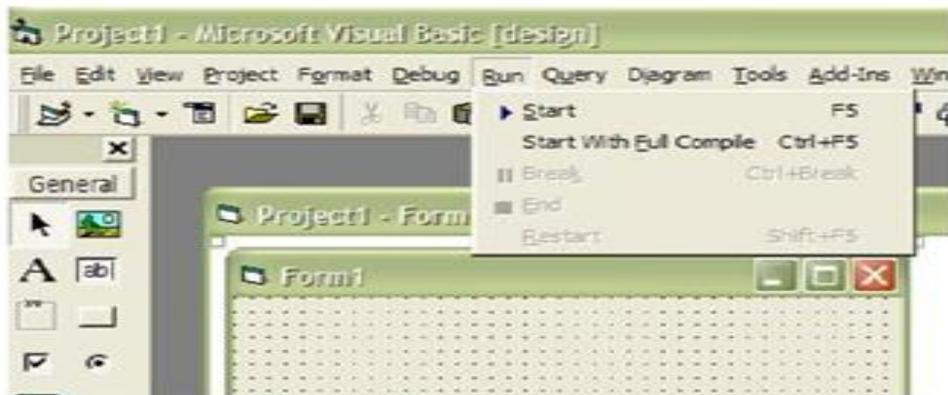
Fig 3: Interpreting and Compiling in VB

VI. EXPERIMENTAL RESULTS

These are the object detection results in the visual basics tool the first two are the input images one with the object and the one with only background. Finally in the output image we can observe the object without background.
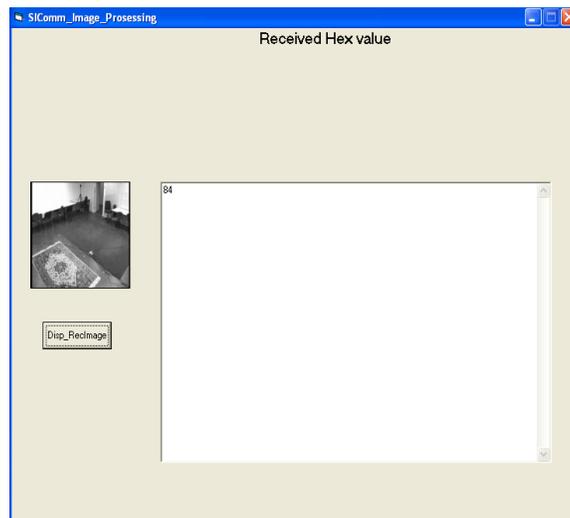
Input image 1 (Background image)
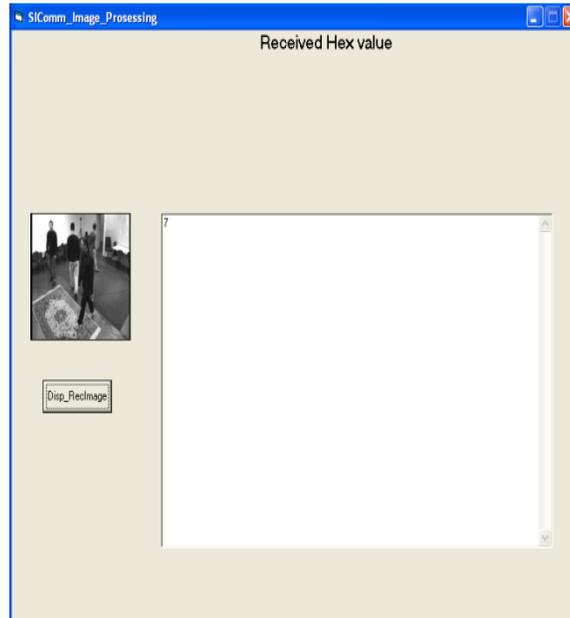
Input image 2 (Foreground image)
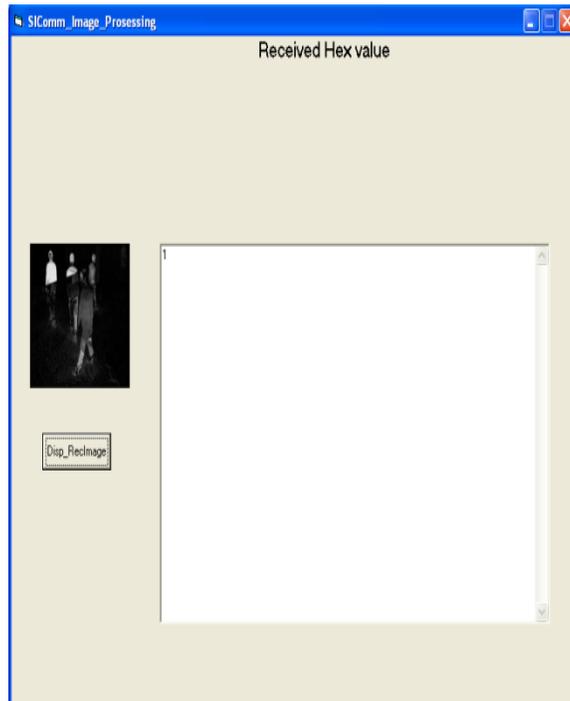
Output image (Background subtraction image)
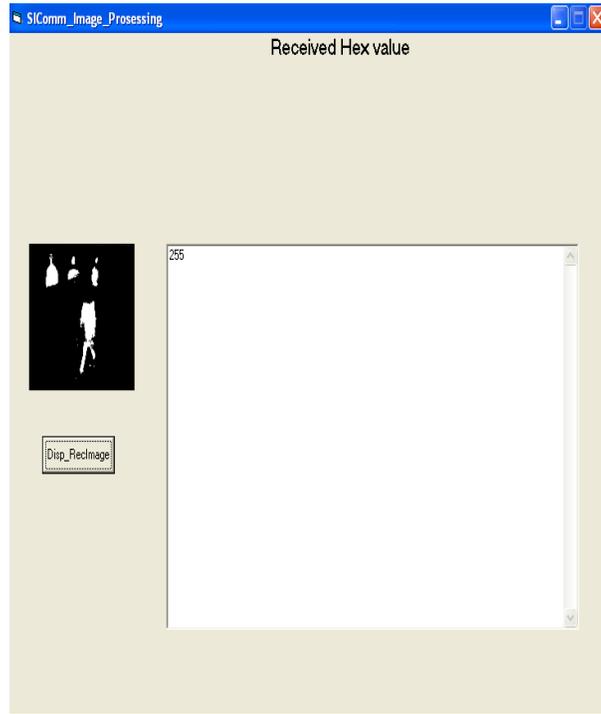
Final Output image (Segmented image)

VII. CONCLUSION

In this work Fpga implementation of selective eigen background using background subtraction algorithm in crowded scenes was developed on a reconfigurable hardware. when compared to the other algorithms like temporal difference and optical flow methods our background subtraction gives a better performance to recognize objects and in the utilization of memory and logic elements.

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