Real Time Monitoring System: Implementation of Face Detection and Recognition Algorithm

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Abstract: ***Face detection and recognition is used in biometric applications to identify the faces in real time. It is compare with the stored database. The objective of this paper is to develop a simulation model. To create a real time hardware monitoring system. It also based on an FPGA platform. The canny edge detection algorithm is used to detect the face edges in real time. The MATLAB used for simulation. The hardware platform can be developed based on altera DE1-SoC development board. An Personal computer monitor and 5 mega pixel TRDB-D5M CMOS camera also used for hardware setup. Verilog HDL used for the programming. The hardware implementation was also based on the Quartus Prime Lite Edison. The canny edge detection algorithm also used here. The alarm system depends on end result of the system.***

Key Words: Quartus Prime, FPGA, edge detection, image processing, Open Computer Vision, TRDB-D5M camera and DE1- SoC board.

I. INTRODUCTION

The corners and edge detection is important in every image processing application. These edges may be the result of changes in light absorption, texture, color and shade. These changes can be used to determine the surface properties of a digital image, depth, angle, shape and size [1]. Edge detection involves filtering. The irrelevant information used to select the edge points based on analyzing of the digital image. The finding of subtle changes may be assorted by noise. This depends on the pixel threshold. It also changes that defines an edge. Detection of these continuous edges is very easier said than done. It is time consuming and very difficult especially when an image is ruined by noise [2].

Edge detectors hold a significance place in modern day computer vision systems [3]. The Edge detection minimizes the amount of data processing, thus the image analysis process is very much simplified [4]. Detecting edges is an important task in boundary detection, motion detection, texture analysis, segmentation and object identification [5] [6] [7]. The main application areas of edge detectors include: pattern recognition systems, military, meteorology medicine, robotics and geography [8] [9]. Biometric is an developing set of pattern acceptance technologies. It used in security systems, which accurately and automatically identified. The other method is to verify individuals based on persons unique physical characteristics. There are many biometric techniques available now days in a market like hand geometry fingerprint, iris pattern, palm print , signature Dynamics, voice recognition, retina pattern, and face recognition[9] [10] [11] etc. Here face recognition system used in this analysis which fulfills the need of vehicle security [12] [13] [14].

Here chose the FPGA as a modular, configurable and flexible hardware platform for image processing and real time video [15] [16]. The Purpose of this board is to provide the ideal path for studying about FPGA board, digital logic and computer organization and logic gates [17] [18]. The most widely used FPGA board powered by Cyclone V, for development of FPGA design and implementation is Altera DE1- SoC development board. The board offers a large set of features. It makes it suitable for use in laboratory environment. Also for the development of digital systems and the variety of design projects.

II. SOBEL OPERATOR

The sobel operator is a combination of Gaussian differentiation and smoothing. The sobel operator is a discrete differentiation operator. It calculates an rough calculation of the gradient of an image intensity function.

The edge operator could be very helpful for carrying out two dimensional spatial pitch sizes on an image. It highlights regions of high spatial gradient that matches the edges. It is typically used to find the complete gradient magnitude at each point in an input image. Fig 1 shows the sobel operator for vertical direction and horizontal. The sobel operator operates two 3x3 kernels. In sobel operator one evaluates the gradient in the y-direction, while the other one estimates the gradient in the x- direction. The image is convolved with both kernels to approximate the derivatives in horizontal and vertical change. At each given point, magnitude of the gradient can be approximated with the given below equation

$$G = ((Gy)^2 + (Gx)^2)^{(0.5)} \quad \text{Equation} \quad (1)$$

This method is faster to compute the gradient magnitude with:

$$G = |GY| + |GX| \quad \text{Equation} \quad (2)$$

The rise to the spatial given by the angle of orientation of the edge by,

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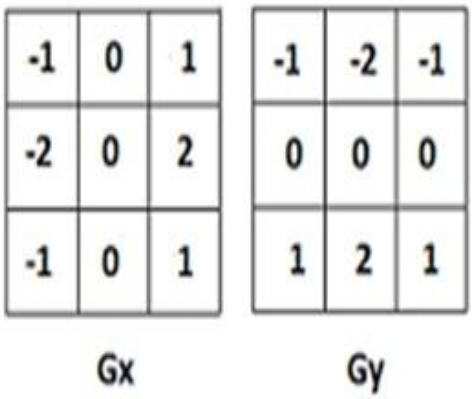

Fig. 1.Sobel matrix operator

$\Theta = \tan^{-1} (Gy/Gx)$. (3)

The normal input image is shown in Fig 2.The sobel edge detection output image are shown in 3

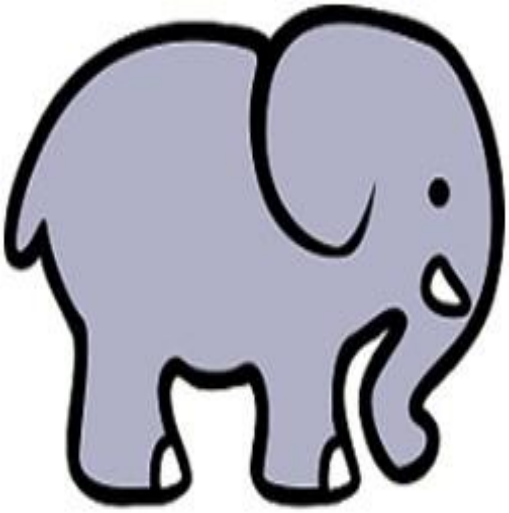

Fig. 2.Input Image

III. PSEUDO CODE FOR SOBEL EDGE DETECTION

Step-i : the color input image are read from camera.

Step-ii : transfer to gray scale image.

Step-iii: Be valid to threshold value to create binary image.

Step-iv: Find the direction of X by derivative (Gx) .Then subtracting the first row from the third row using the mask.

Step-v : Find the direction of Y by derivative (Gy).Then subtracting the first column from the third column using the mask.

Step-vi: From the equation 2 find the gradient G.

Step-vii: Repeat the steps from ii to iv. This is for whole pixels in an image.

Step-viii: After that the output image is displayed.

IV. SIMULATION RESULT

MATLAB simulation is used for face recognition and edge detection. Fig.4 is shown the input Image.

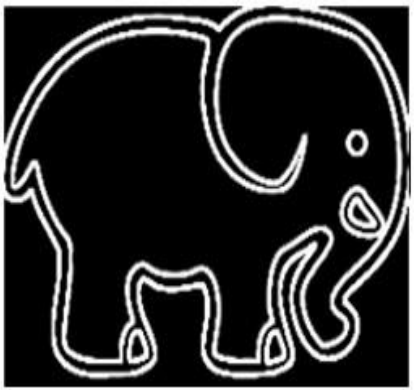

Fig.3. Output Image

The simulation result of normal input image and sobel output image respectively in Fig 5.

V. SYSTEM ARCHITECTURE

The system architecture based on Altera Cyclone V DE1-SoC FPGA processor is presented in Fig.8.In the Altera DE1-SoC board 5 Megapixel digital camera provided by The TRDB_D5M camera. This camera is used to detain the image which is used as input to sobel face recognition module and edge detection algorithm. The processor unit deals with edge detection face recognition, data transmission, and image decoding to the PC monitor through VGA controller. The on-chip SRAM is kept to accumulate the project code. The DDR3 SDRAM is used to store the grayscale. It also stored the binary images data generated by face recognition module.

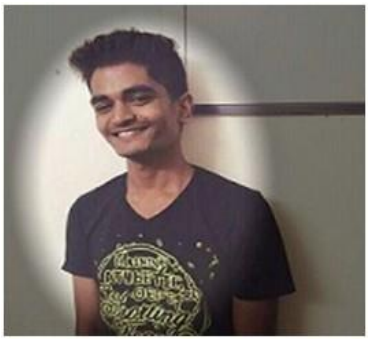

Fig. 4. Input Image

Fig. 5.Output Image

The processor processes the incoming signals from camera unit. It also sends the output data to output units i.e. Door motor control system Alarm system and PC.

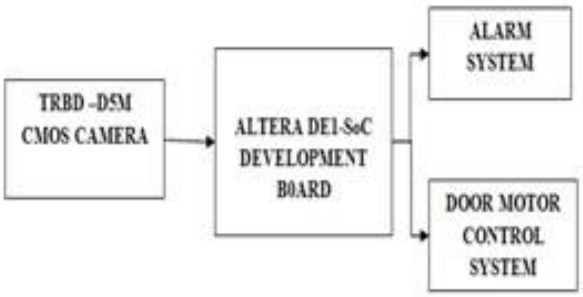

Fig. 6. System Architecture

VI. FACE RECOGNITION

To detection of the edges of the face in the images and to extract features is done by using the Sobel Edge detection algorithm. The edges records at the output of sobel module are second-hand as input to "Face Recognition Module". The row having maximum summation of edge data values in two halves used for face recognition module algorithm. By using the row summation, for every "zero"output of sobel module corresponding "one"is added. Summation of row values of "five" rows is stored .The average is calculated.

The maximum average value in the first half is stored. The corresponding row is stored as "Row having the Eye Feature". The same process is continual for other half to get the "Row having Mouth Feature". After obtaining these row feature values the difference in the corresponding rows is computed. Then the value is stored. This difference is used to recognize the face. The flow of the processing is shown in Fig.7.

VII. FLOW CHART

Fig. 7. Experimental Setup

VIII. HARDWARE

The experimental setup for face recognition module is shown here. Fig.6. The Altera DE1 SoC- board has cyclone V on chip family which has combination of FPGA logic blocks and hard processor system. It shows the complete setup for TRDB-D5M CMOS camera interfacing with Altera DE1-SoC development board with a power supply of 12V.

This board has a special aspect which has USB-blaster II communication protocol to easily communicate with the PC. It has a VGA port to displays the output. The output is from the inbuilt SDRAM of board to monitor.

It has minimum of 15 fps for full resolution and maximum up to 70 fps. In the camera 640*480 high resolution capacity is available in the TRDB-D5M. The camera has a, horizontal and vertical images. It has an on chip PLL.

The Altera DE1-SoC development board and TRDB-D5M CMOS camera are shown in Fig.9 and Fig.10 respectively.

Fig. 8 DE1-SoC Board

Fig. 9 TRDB –D5M Camera

IX. HARDWARE RESULT

The input image shown on the PC monitor is shown in Fig.11

The sobel output edge detection images shown on the monitor is shown in Fig.12.

Fig. 10. Input Image

Fig. 11. Output Image

The image is captured from camera. Then it converts from color image in to gray scale. The binary image used to perform other image processing steps. Finally perform edge detection operation .The processed image is stored in SDRAM. This stored image is compared with present image. If the face is familiar with the present image in SDRAM is matched with the stored image then the output signal is send to the door motor control system. Otherwise alarm system will ring. Then SMS is sent to the corresponding person.

X. CONCLUSION

There are so many controllers available in market to do an image and video processing. FPGA platform is a powerful tool compared to other controller for video and image processing. It provides a high resolution videos and images. Use to interfacing the camera in it. This has a high speed processor to capture the video and images. It also given to the output side simultaneously without any delay. The face recognition algorithm with high motion videos using an FPGA can be implemented at any types of automobiles. It could be used at any place where face recognition is needed. However the results varied. Due to restrictions of system based on facial recognition such as intensity of light changes in background conditions and facial expression. This system is reconfigurable and portable. So it can be programmed. It deployed at security systems for Law enforcement at airports, military, geography, pattern recognition systems, robotics, medicine, meteorology, and international borders customized according to their requirements.

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