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AUTOMOBILE SECURITY SYSTEM: IMPLEMENTATION OF FACE RECOGNITION ALGORITHM ON FPGA PLATFORM

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***Abstract*– Face recognition is a form of biometric identification that relies on data acquired from face of individuals & compared with the database of individuals. The objective of this paper was to develop a real time hardware face recognition system based on Field Programmable Gate Array (FPGA). The chosen image processing algorithm is Sobel Edge Detection algorithm. The hardware platform is based on Altera DE2-70 development board with TRDB-D5M 5 Mega pixel digital camera and LCD Touch Panel Module (LTM) board from Terasic Technologies. Verilog HDL was used as hardware programming language for real time sobel edge detection system using Quartus II 13.1 web edition. The final output of the system is given to the Alarm system and Door motor control system.**

***Keywords*- FPGA, Sobel Edge Detection, DE2-70 development board, Quartus II 13.1, LTM Screen, TRDB-D5M Digital Camera.**

I. INTRODUCTION

Biometric is an emerging set of pattern recognition technologies used in security systems, which accurately and automatically identifies or verifies individuals based on person's unique physical or behavioral characteristics. There are many biometric techniques available now days: fingerprint, figure and hand geometry, palm print, iris pattern, retina pattern, face recognition, voice recognition, signature dynamics etc. We chose and developed a face recognition system [1] in our project which fulfills the need of vehicle security so as to prevent vehicle theft [2][3].

We chose the FPGA as a modular, configurable and versatile hardware platform for real time video and image processing [4]. Altera DE2-70 development board becomes one of the most widely used FPGA board powered by Cyclone II, for development of FPGA design and implementation. The Purpose of this board is to provide the ideal path for learning about FPGA, digital logic and computer organization. The board offers a large set of features that make it suitable for use in laboratory environment for the variety of design projects and for the development of digital systems [7].

II. SYSTEM ARCHITECTURE

In Fig.1the system architecture based on Altera Cyclone II 2C70 FPGA processor is presented. The TRDB_D5M camera kit provides a 5 Megapixel digital camera on the Altera DE2 board [8]. This digital camera is used to capture the image which is used as input to Sobel edge detection algorithm and face recognition module. The processor unit deals with image decoding, edge detectionface recognition and data transmission to the output unit. The on-chip SRAM is used to store the project code while an external SDRAM is used to store the grayscale and binary images data generated by face recognition module.The processor process the incoming signals from camera unit and send the output data to output units i.e. LCD touch panel module, Door motor control system and Alarm system.

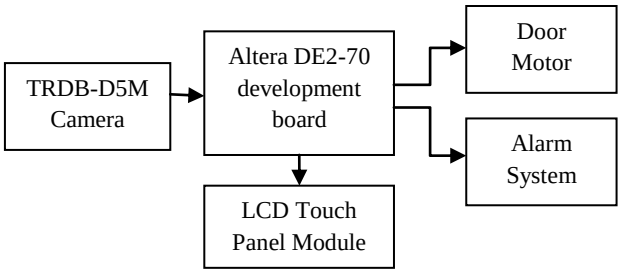

Fig. 1 Block diagram of the system

II. SOBEL EDGE DETECTION

Edge detection is a fundamental tool used in many image processing applications to obtain information from the frames before feature extraction and object segmentation. This process detects outlines of an object and boundaries between objects and the background in the image. Different methods of edge detection are Sobel, Prewitt, Roberts, Laplacian of Gaussian, Zero crossing and Canny edge detectors [5].

The sobel operator performs a 2D spatial gradient measurement on an image and emphasizes regions of high spatial frequency that correspond to edges. It is used to find the approximate absolute gradient magnitude at each point in an input grayscale images. The operator consists of a pair of 3×3 convolution kernels which are convolved with the original image to calculate approximations of derivatives, one for horizontal changes and one for vertical changes [6].

$$Gx = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} Gy = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

The gradient magnitude is given by,

$$|G| = \sqrt{Gx^2 + Gy^2}$$

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

$$\theta = \tan^{-1}\frac{Gy}{Gx}$$

IV. FACE RECOGNITION

Sobel Edge detection algorithm is used to detect the edges of the face in the images and to extract features. The edges data at the output of sobel module is used as input to "Face Recognition Module". Face recognition module has the algorithm that detects the row having maximum summation of edge data values in two halves. For every '0' output of sobel module corresponding '1' is added to the row summation. Summation of row values of "5" rows is stored and average is calculated. The maximum average value in the first half is stored and the corresponding row is stored as "Row having the Eye Feature". The same procedure is repeated for other half to get the "Row having Mouth Feature". After obtaining these row feature values the difference in the corresponding rows is computed and stored. This difference is used to recognizetheface, the processing flow of the system is as shown in Fig.2.

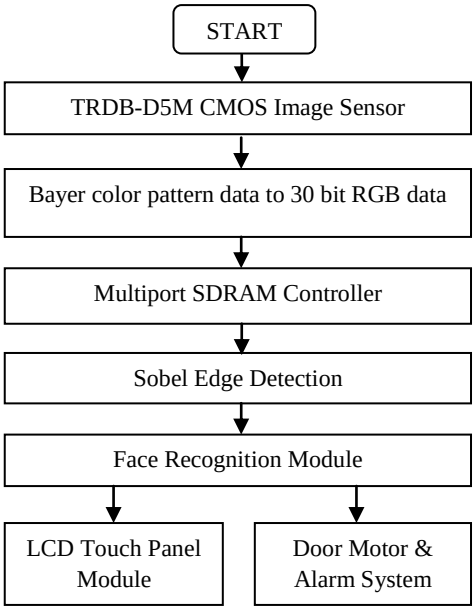

Fig.2 Flow chart of Face Recognition

V. RESULT

The output images of Gray scale and Sobel edge detection on the LCD touch panel module (LTM) is as shown in Fig.3. The image is captured and the row feature values of "Rows having Eye feature" & "Rows having Mouth feature" is computed and stored in SDRAM. This stored value is compared with predefined values and if the face is recognized the output signal is given to the Door motor control system otherwise given to the Alarm system.

(a)

(b)

Fig. 3(a) Grayscale Image (b) Sobel Edge Detection Images

VI. CONCLUSION

Face recognition algorithm are successfully implemented on Altera Cyclone II FPGA using Sobel edge detection. This system can be implemented at any types of automobiles and can be used at any place where face recognition is needed.However the results may vary due to certain limitations of system based on facialrecognition such asintensity of lightchanges in facial expressions and background conditions.This system is portable and reconfigurable therefore it can be programmed and deployed at security systems for law enforcement at airports and international borders customized according to their requirements.

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