International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-12, October 2019

Realization of Biometric based Elevator Controller using FPGA

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Abstract*: the elevator have become an essential part of every skyscraper with high number of malls, hotels, complexes and skyscrapers. It is a system which is used for transferring individuals to particular floor inside any multi storey building. To secure entrance of lab, research centres and hospitals, biometric access is implemented in elevators. The doors of elevator would open only if a person's biometric attributes are identified by facial, fingerprint or eyes. Biometrics has been gaining great importance in this technical world because it is based on an individual's attributes. Vein fingerprints based controller elevator by using FPGA has been proposed in this work. For this, Verilog HDL and Xilinx ISE tools are used for simulating and coding the controller.

***Keywords*: Biometrics, Elevator Controller, FSM, Vein Fingerprints.**

I. INTRODUCTION

The world's first ever known elevator was made in 236 BC by Archimedes. The first elevator based on safety was demonstrated in 1852 by Otis and the first elevator for passengers was installed by him in the year 1857. In the year 1874, JW Meeker patented a method that ensures safe opening and closure of the doors of an elevator. In the year 1929, Clearance Conrad created the first elevator for residence. An elevator controller is a finite state machine (FSM) in its basic form. It is used for designing computer programs or digital logic circuit mathematically. The elevator controller based on biometric proposed here depends on Mealy machine because its output depends on its current inputs and current state. During 6000 to 7000 BC, ancient civilizations of Chinese recognised a person through fingerprints. Biometrics are trusted means of recognizing and verifying credentials of a person because it is not possible for an individual to forget or lose his biometric attributes. Furthermore, it is also not possible to duplicate or copy anyone's attributes and an individual's presence is required at the time of verification[1]. There are three categories of fingerprint recognition: Correlation based, Minutiae based ridge and gradient based.

Revised Manuscript Received on October 30, 2019.
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This paper presents an approach for developing a reliable and cost effective elevator controlled based on biometric by using FPGA[2].

II. FIELD PROGRAMMABLE GATE ARRAY (FPGA)

FPGA belongs to a class of "Programmable Logic Devices" (PLD's) integrated circuit. The programmer can use PLDs in various ways and allowing a programmer interfacing of different size and complexities digital logic circuits. FPGA allows interconnection of logic blocks by reconfigurable interconnections and it comprises of a programmable logic components. PLDs perform few complex combinational functions and simple logic functions. Logical functions are implemented by FPGAs[3]. The advantage of using FPGA over ASIC is that as per the desire, FPGA can be programmed by users. ASIC cannot be reprogrammed by a user like FPGA because it is designed for a particular specification. The FPGA has following components: Interconnect Resources, Input and output blocks and Programmable Logic Blocks.

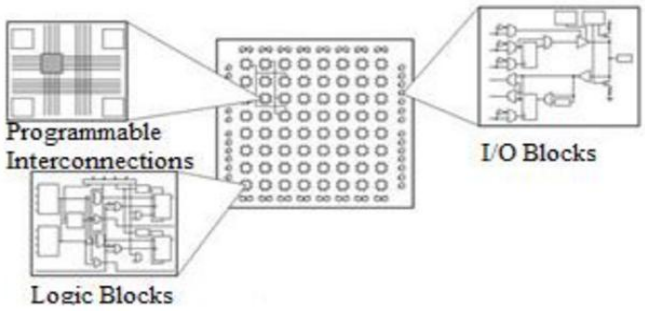

Fig. 1. Architecture of FPGA

III. ELEVATOR CONTROLLER

A. Working of elevator controller

An elevator controller is developed by considering few design points such as speed, reliability and cost-effectiveness etc. The positions of a lift are detected by using proximity sensors [4]. The controller unit is responsible for checking any pending requests from other units of elevator by using flip flops. The timer of an elevator signals the controller unit that an elevator is busy if the gate is open.

B. Control State Machine (CSM)

All the commands and instructions are comprised in a "control state machine" (CSM). The entire system's operation is controlled by a predefined algorithm program. The control instructions and commands are produced by CSM for moving the elevator to its next destination.

For calling an elevator, button is pressed by a person and a request instruction to main controller is sent by a sensor which is present in button and then the floor on which user is willing to go identified by the system. On facing a new request, it is moved to a list of floor. When an elevator is in standstill position, the elevator control system detects the direction of movement of elevator for serving new request when the button of elevator's door is pressed. Based on the pressed button, elevator starts to move upwards or downwards as the dc motor inside an elevator receives an instruction with the closing of a door. When people are carried between the floors, the elevator's arrival on the floor is detected by a proximity sensor and the elevator is stopped when an instruction is sent to the system for opening elevator's door.

C. Functioning of an elevator system

There are some conflicts which are faced during the operation of system such as which unit of elevator is allowed to follow elevator's call when both of them are present at equal time. Thus, some assumptions are assigned in an algorithm for elevator. These are as follows: Priority of Elevator- all the elevator control systems consist of elevator 1 which is responsible of dealing with requests from the first floor and all the request from second floor are dealt by elevator 2. Default State- the elevator 1 at first floor with gate closed should be set and elevator 2 at second floor with closed gate. Closing the door of elevator: the program predefines the closing time of an elevator and automatic closing of elevator's gate after sometime is required. During the closing of gate, count 0 should be counted by a timer and count 1 should be counted after the gate is closed.

IV. BIOMETRICS

Biometrics is a reliable technique for distinguishing an authorized person from an imposter in comparison with other conventional techniques. Biometrics identifies the behavioural and physiological attributes of an individual like face pattern, handwriting, fingerprint, voice, etc. The system which is capable of successfully recognizing and verifying an individual's biological attributes is called a biometric system. One of the most trusted methods of recognizing and verifying a person is biometrics security systems. The fingerprints are the oldest known attributes among all biometrics. This paper aims at developing an elevator controller based on veins of fingerprint which authorizes limited people to access an elevator.

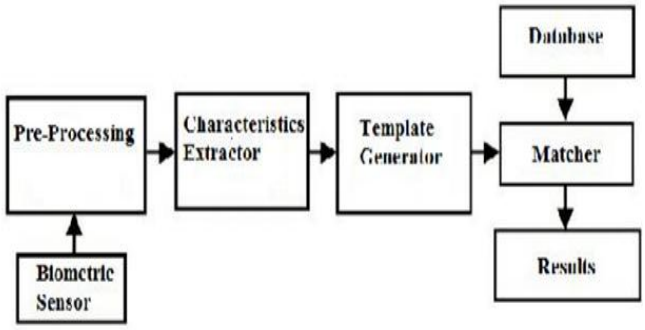

Fig. 3. Biometric System

V. DESCRIPTION AND ARCHIETCTURE OF A SYSTEM

The system proposed here uses a low cost modified IR webcam which is connected to a PC for capturing the vein pattern. This method uses an IR sensor of wavelength 1000nm. The haemoglobin and blood vessels of an individual are scanned by an IR sensor for noting down the finger vein patterns in the database of a system [5]. This controller uses a NIR technique with a light transmission technique. The image is captured by putting finger in between an image acquisition module and infrared LED and an IR filter is used in this purpose. The resulting image has darker captured vein patterns. Image has 3 bytes per pixel with 320wx240h pixels. For recognizing and verifying, the transfer of captured image to FPGA system on chip is done, which contains feature extraction, pre-processing and template matching. In the fingerprint registration, templates are stored in flash memory in the database, thus strong security is provided. The fingerprints are presented to the system for verifying a person and all the data in s database is scanned one by one. This scan helps in determining a genuine user of an imposter.

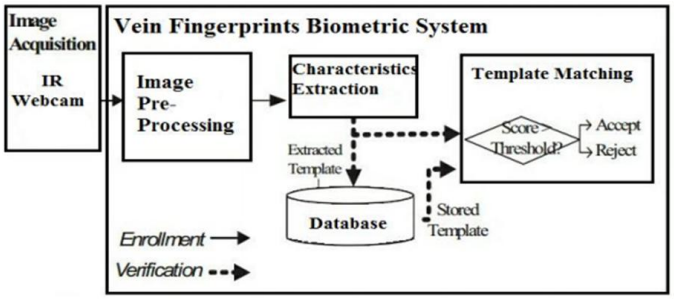

Fig. 4 Proposed Biometric System

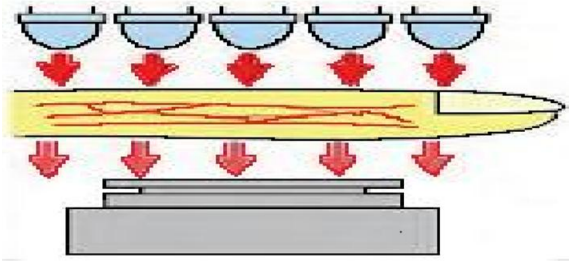

Fig. 5 Imaging technique of finger vein pattern

VI. PROPOSED SYSTEM

FPGA used fingerprint vein based elevator control system has been proposed here. This system is capable of protecting an elevator from an unauthorized access by ensuring more security [5]. The authorized users have their vein fingerprints stored in the database and to open the door of elevator, verification of fingerprints in necessary. If both, the stored vein fingerprints and image of vein fingerprints match then the door of elevator will open, hence allowing the user to access the elevator [5]. The figure 6 illustrates the architecture of system proposed in FPGA-SOC platform [6]. The hardware-software partitioning is allowed for speed trade off at effective cost.

The co-design methodology has been applied to achieve speed performance. The Nios 2 Linux RTOS are present in flash memory and on-board SDRAM and a template database as well.

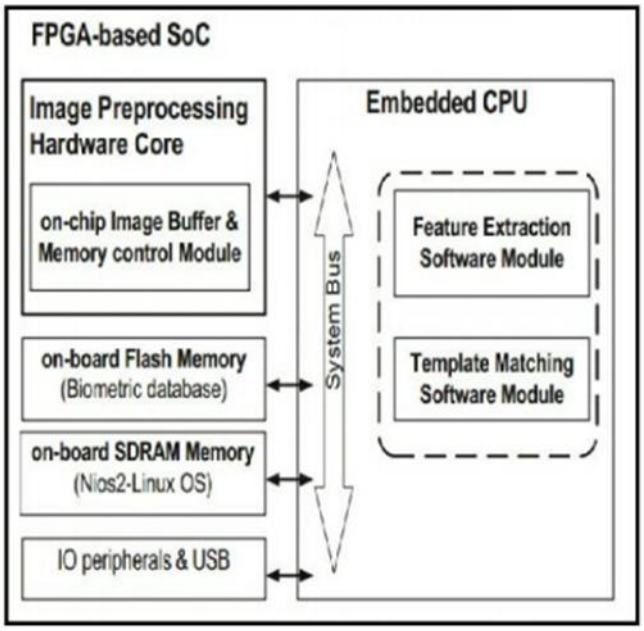

Fig. 6 Proposed biometric system's system architecture

VII. RESULTS AND DISCUSSIONS

This paper proposes an elevator controller based on biometric. The Xilinx-ISE tool is used for designing this elevator system. Verilog HDL is used for completing the programming of a controller[2][7]. Thus, the results prove that an elevator controller based on vein fingerprint is much more secure than conventional technologies. The simulation results prove that after the signals pass through FPGA, the translation and transformation of signal moves towards the output rapidly.

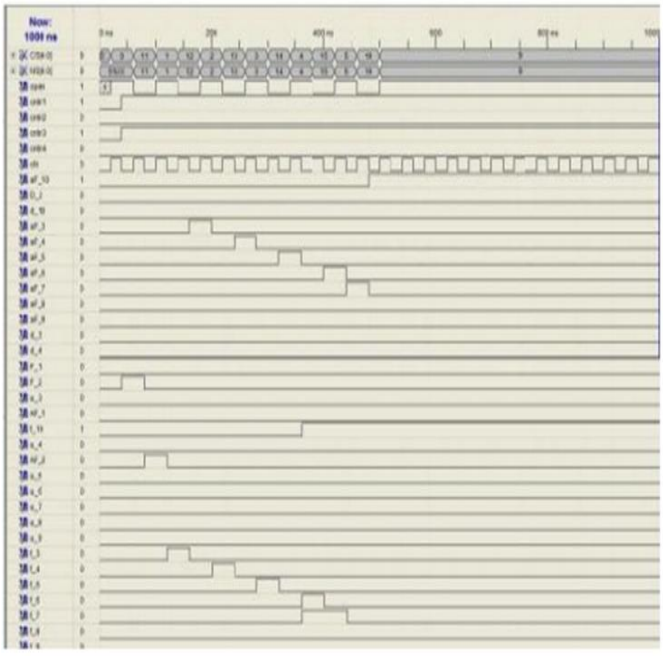

Fig. 7. Simulation Result

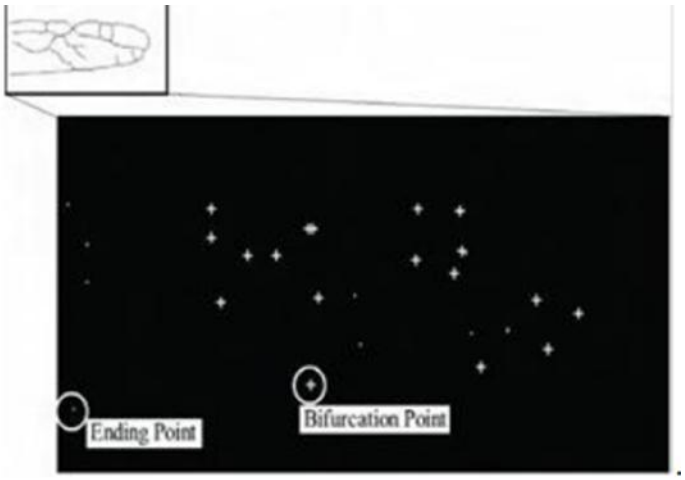

Fig. 8 Extracted Minutaie of sample vein of fingerprint

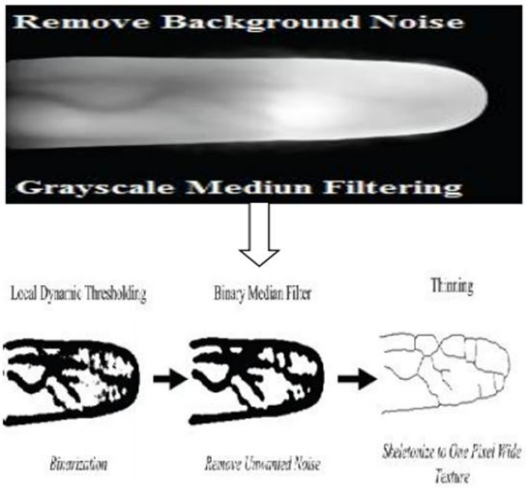

Fig. 9. Output image of image processing

At a clock of 50 MHz, prototyping of SOC is done on development board of Altera Nios2 FPGA which runs Nios2-Linux operating system.

VIII. CONCLUSION

The biometric based elevator controller is more reliable, stable and secure as compared to traditional techniques of biometric verification and recognition. FPGA [8] offers numerous advantages in comparison with microcontroller. Thus, it is cost effective to design elevator controller based on FPGA. For developing FPGA based elevator controller very few resources are required and simulation is done by altera Nios2 FPGA prototype board. It utilizes minimum available hardware resources and requires low processing time as well as power consumption. Errors can be reduced by improving the vein fingerprint image quality and thus, increasing the reliability of a system.

REFERENCES

1. C. Li, J. Hu, J. Pieprzyk, and W. Susilo, "A New Biocryptosystem-Oriented Security Analysis Framework and Implementation of Multibiometric Cryptosystems Based on Decision Level Fusion," *IEEE Trans. Inf. Forensics Secur.*, 2015.
2. S. Palnitkar, "Verilog HDL a guide to digital design and synthesis," *J. Chem. Inf. Model.*, 2013.
3. K. Schabas and S. D. Brown, "Using logic duplication to improve performance in FPGAs," 2004.
4. J. Katrib, P. Poure, S. Karimi, and S. Saadate, "Design methodology of VLSI Power Electronics digital controller based on Matlab-Modelsim co-simulation," in *IEEE International Symposium on Industrial Electronics*, 2008.
5. L. Wang and G. Leedham, "Near- and far- infrared imaging for vein pattern biometrics," in *Proceedings - IEEE International Conference on Video and Signal Based Surveillance 2006, AVSS 2006*, 2006.
6. H. P. A. P. Jayawardana, H. W. K. M. Amarasekara, P. T. S. Peelikumbura, W. A. K. C. Jayathilaka, S. G. Abeyaratne, and S. D. Dewasurendra, "Design and implementation of a statechart based reconfigurable elevator controller," in *2011 6th International Conference on Industrial and Information Systems, ICIIS 2011 - Conference Proceedings*, 2011.
7. M. D. Ciletti, "Advanced digital design with the Verilog HDL," *Prentice Hall Xilinx Des. Ser.*, 2003.
8. Y. Zhao and M. Ma, "Implementation of six-layer automatic elevator controller based on FPGA," in *2010 6th International Conference on Wireless Communications, Networking and Mobile Computing, WiCOM 2010*, 2010.