FPGA IMPLEMENTATION OF EMERGENCY DOOR CAR ENTRY SYSTEM

ZAINI BIN SULAIMAN

SCHOOL OF MICROELECTRONIC ENGINEERING
UNIVERSITI MALAYSIA PERLIS
2007

FPGA IMPLEMENTATION OF EMERGENCY DOOR CAR ENTRY SYSTEM

by

ZAINI BIN SULAIMAN

Report submitted in partial fulfillment
of the requirements for the degree
of Bachelor of Engineering

MAY 2007

ACKNOWLEDGEMENT

I am grateful and deeply indebted to a number of individuals who helped to make this thesis possible.

I would like to express my deepest and highest gratitude to my supervisor, Pn. Norhawati bt. Ahmad, whose support; patience, encouragement, guidance and advice throughout my project have been invaluable to me. Also for En. Muammar bin Mohd Isa for his bright ideas and support for commencing this project. It has been a tremendous learning experience and I am truly honored and privileged.

I would also like to acknowledge my colleagues Mohd. Khairul Akli and Yeap Say Hong, who shared the same research interest; which the many discussions we have had have benefited me greatly. Special gratitude also goes to Abg. Abu Bakar, Abd. Rahim, Abd. Salam, Shafarizan, Syaharul Nizam, and Mohd. Hariz for the time spent with me enriching ideas as well as in the form of assistance.

My deepest appreciation, thanks and love goes to my family, and Claudia who have always been very supportive and ever willing to share all my joy and pain.

Finally, my heartfelt appreciation goes to all, who have directly or indirectly contributed in completing this study.

APPROVAL AND DECLARATION SHEET

This project report titled FPGA Implementation of Emergency Door Car Entry System was prepared and submitted by Zaini bin Sulaiman (Matrix Number: 031030536) and has been found satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the Bachelor of Engineering (Electronic Engineering) in Universiti Malaysia Perlis (UniMAP).

Checked and Approved by

_____

(PN. NORHAWATI BT. AHMAD)
Project Supervisor

School of Microelectronic Engineering
Kolej Universiti Kejuruteraan Utara Malaysia

May 2007

IMPLEMENTASI SISTEM KEMASUKAN PINTU KERETA UNTUK KECEMASAN KE ATAS PAPAN LAPANGAN BARISAN GET TERPROGRAM

ABSTRAK

Sisitem kemasukan pintu kereta untuk kecemasan boleh diimplementasikan menggunakan Papan Lapangan Barisan Get atau Field Programmable Gate Array (FPGA). Papan FPGA adalah sejenis papan litar yang boleh diprogramkan dengan menggunakan kod-kod sumber untuk menjalankan aplikasi yang telah dimasukkan ke dalamnya. Papan litar yang digunakan ialah Altera® UP2 Education Kit. Kit ini mengandungi segala peralatanyang diperlukan untuk membuat sistem-terprogram-atas-chip (SOPC) yang lengkap. Chip yang terbina di dalam papan litar tersebut ialah MAX® EPM7128S dan FLEX® 10K EPF10K70-240. ByteBlaster™ II ialah kabel pengantaramuka antara pemuka pencetak (LPT1) pada komputer dengan papan FPGA. Microsoft® Corporation Windows® XP Professional Service Pack 2 adalah sistem pengoperasi yang digunakan kerana sistem ini dapat menampung pengoperasian papan FPGA. Terdapat pelbagai jenis bahasa kod yang boleh digunakan untuk mengoperasikannya. Paling luas digunakan ialah VHSIC Hardware Description Language (VHDL) dan Verilog. VHSIC ialah singkatan bagi Very High-Speed Integrated Circuits (Sistem Terkamir Berkelajuan Sangat Tinggi). VHDL digunakan untuk mengaplikasikan sistem digital pada pelbagai tahap penggunaan bermula dari tahap algoritma sehinggalah tahap get. Verilog adalah untuk tujuan yang sama, tetapi dituliskan dengan menggunakan format yang berlainan. Projek ini menggunakan Verilog sebagai bahasa kod. Altera® Quartus II adalah perisian yang digunakan untuk memuatturunkan bahasa kod ke dalam papan FPGA. Simulasi pula dijalankan dengan menggunakan perisian Simulator Tool dalam Altera ® Quartus II. Sistem kemasukan pintu kereta untuk kecemasan adalah sistem yang mengawal kemasukan ke dalam

sesuatu, dengan menggunakan sedikit sahaja tindakbalas daripada manusia. Suis tekan yang biasa digunakan sebagai cara untuk memasukkan kata kunci dan akses. Berdasarkan pernyataan tersebut, kod sumber boleh dibuat. Walaupun keluaran daripada sistem tersebut hanyalah menggunakan diod pemancar cahaya (LED), ia mamadai untuk menunjukkan bahawa implementasi sistem tersebut telah berjaya. Hanya dengan memasukkan kata rahsia yang tepat sahaja seseorang itu boleh mendapat akses.

FPGA IMPLEMENTATION OF EMERGENCY DOOR CAR ENTRY SYSTEM

ABSTRACT

Emergency door car entry system can be implemented using Field Programmable Gate Array (FPGA) board. FPGA board is a board that can be programmed using source code to run the application that has been downloaded into it. The commonly used board is the Altera® UP2 Education Kit. This kit contains everything that is needed to create a complete system-on-a-programmable-chip (SOPC) solution. Onboard chips are MAX® EPM7128S and FLEX® 10K EPF10K70-240. ByteBlaster™ II Download Cable is the cable used to interface the board to computer's printer (LPT1) port. Microsoft® Corporation Windows® XP Professional Service Pack 2 is used as the operating system that supports the FPGA board. Different types of source codes can be implemented to the board. Widely used are VHSIC Hardware Description Language (VHDL) and Verilog. VHSIC is an acronym for Very High-Speed Integrated Circuits. VHDL can be used to model a digital system at many levels of abstraction ranging from the algorithmic level to the gate level. Verilog is of the same goal, but it is written using a different format. Verilog is chosen as the source code's format for the keyless auto entry system. Altera® Quartus II is used to create the source code and download it into the FPGA board. Simulation is done using Simulator Tool in Altera ® Quartus II software. Emergency door car entry system is an access control system, using minimal human effort to have the access. Standard pushbuttons are used as input method and the access depends only on the input timing. These rules are used to write the source code. Although the outputs are represented using light emitting diodes (LEDs), the result and performance is correct. Access can only be reached when the entered password is correct.

TABLE OF CONTENTS

		Page
ACKNOWLEDGMENT		ii
APPROVAL AND DECLARATION SHEET		iii
ABSTRAK		iv
ABSTRACT		vi
TABLE OF CONTENTS		vii
LIST OF TABLES		x
LIST OF SYMBOLS, ABBREVIATIONS OR NOMENCLATURE		x
LIST OF FIGURES		xi
CHAPTER 1 INTRODUCTION		
1.1	Background of Door Car Entry System	1
	1.1.1 Authentication	1
	1.1.2 Authentication Methods	2
1.2	Problem Statement	3
1.3	Objective	4
1.4	Scope of Project	4
1.5	Organization of thesis	5
CHAPTER 2 LITERATURE REVIEW		
2.1	Background of Study	7
CHAPTER 3 METHODOLOGY		
3.1	Introduction	9

Page

3.2 System Design 11
.2.1 The Altera Quartus® II Software 12
.2.2 Source Code 13
.2.3 Compiling 17
.2.4 RTL Viewer 18
.2.5 Simulator Tool 18
.3 Using the FPGA Board 21
.3.1 Configuring the FPGA board 23
.3.2 Setting up Programming Hardware in Quartus II Software 23
.3.3 Downloading Source Code 24
3.5 Hardware Simulation Setup 25
3.5 Summary 26

CHAPTER 4 RESULTS AND DISCUSSION

4.1 Introduction 27
4.2 Source Code Design 28
4.3 Source Code Simulation
4.3.1 Source Code Simulation Summary 31
4.4 Hardware Simulation Result 31
4.5 Discussion 35
4.6 Summary 35

CHAPTER 5 CONCLUSION

5.1 Conclusion 36
5.2 Recommendation for Future Project 37
5.3 Commercialization Potential 37
5.3.1 Advantages 37
5.3.2 Strategy for Commercialization 38
5.3.2.1 Financial 38
5.3.2.2 Strategy Selection 39
5.3.3 Factors that Affect Commercialization Strategy 39
5.3.4 Competitors 40

Page

5.4 Summary 40

REFERENCES 41

APPENDICES

Appendix A 43

Appendix B 47

LIST OF TABLES

Tables No.		Page
3.0	Display Assignments for Seven Segments	15
3.1	Pin Assignments for the FPGA board	25
3.2	Pins Connection on the FPGA board	25
4.1	Initial Condition	31

LIST OF SYMBOLS, ABBREVIATIONS OR NOMENCLATURE

Ω	Resistance (ohm)

LIST OF FIGURES

Figures No.		Page
1.0	Design tradeoff for security system	3
3.1	Flowchart showing work plan on the study	10
3.2	CAD Design Flow	12
3.3	Seven Segments Labeling	14
3.4	State Diagram for version_11.v	16
3.5	Window after a successful compilation	17
3.6	Simulation start window	19
3.7	Entering pins for the waveform window	20
3.8	Successful simulation waveform windows	20
3.9	Pin Assignments window	21
3.10	Altera FPGA Board	22
3.11	Jumper Settings for Configuring FLEX10K70	23
3.12	Connected ByteBlasterII cable	24
3.13	Hardware Wiring	26
4.1	Reset and Initial Condition	28
4.2	Entering Passkeys	29
4.3	Unlocking Door	30
4.4	Locking Door	30
4.5	Initial Hardware Condition	32
4.6	Idle Condition	32

4.7	Button A Pressed and the Labeling	33
4.8	Button B Pressed	33
4.9	After Button C is Pressed	34
4.10	Unlocking	34
A	RTL View of the Emergency Door Car Entry System	47