

**DESIGN AND IMPLEMENTATION OF ELEVATOR CONTROLLER ON A  
FPGA**

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**This report is submitted in partial fulfillment of the requirements for the award  
of Bachelor of Electronic Engineering (Computer Engineering) With Honors**

**Faculty of Electronic and Computer Engineering**

**University Technical Malaysia Melaka**

**JUNE 2012**



UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN  
PROJEK SARJANA MUDA II

Tajuk Projek : DESIGN AND IMPLEMENTATION OF ELEVATOR  
CONTROLLER ON A FPGA  
Sesi Pengajian : 

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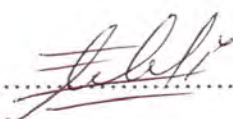
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For my lovely mum and dad, thanks for sacrifice towards my success.

For my supervisor, Ms Siti Aisah Binti Mat Junos@ Yunus, thanks for all your supports

To my friends who's helped me lots, I'll appreciate very much

## ACKNOWLEDGEMENT

First and foremost, I would like to give Thanks to ALLAH SWT, for helping me. I would like to express my appreciation to my supervisor, Ms Siti Aisah Binti Mat Junos@ Yunus for her support and guidance throughout this whole project. To my beloved parents who always give me support and never tired of convincing me in order to achieve my determination and finishing my study without any delay. They always support me and understand me while giving me opportunity in completing all my projects.

Besides that, I am also thankful to all the lecturers that also giving me some ideas and knowledge that can be used to accomplish the PSM project. Not forgotten to my friends who had also helped me in giving their thought, pro and contra of each of the research and result that had obtained.

Once again for the last time, I would like to express my gratitude to those people that already mentioned above as well as the BENC's student Faculty of Electronic and Computer Engineering who provide many suggestions, information, and criticism and sustain in this report.

## ABSTRACT

The project title is Design and Implementation of Elevator Controller on Field Programmable Gate Array (FPGA). The elevator controller will be fully design on the FPGA board using simple I/O interface on the FPGA board. The controller will be use in any type of elevator and it will produce a single chip controller compare to other controller that will need more than one chip.

The project was design on FPGA. The programming language that use for the project is Verilog, which is one of hardware description language (HDL) that can support by FPGA. The software that uses to write the programming language is Xilinx ISE. When the programming design is done, the next step is the simulation of the behaviour of the system. The simulation of the program is making in Model SIM PE Student Edition. When all the programming is complete, the programs need to implement on the Xilinx Spartan II FPGA board.

This project will build an elevator base on 10 floor building. The elevator will move up and down depend on the request from the user. By using the FPGA the result is will be easily to upgrade due to the reconfigurable of the pin on the FPGA. If the elevator require more floor, it will more easy to redesign.

## ABSTRAK

Tajuk projek adalah Reka Bentuk dan Perlaksanaan Pengawal Lif pada “*Field Programmable Gate Array (FPGA)*”. Pengawal lif ini direka sepenuhnya dengan untuk ”FPGA Board” menggunakan system I/O antara muka pada “FPGA board”. Pengawal lif ini boleh digunakan pada mana-mana sahaja jenis lif dan ianya dapat menghasilkan pengawal cip tunggal berbanding pengawal lain yang memerlukan lebih dari satu cip.

Projek ini direka pada FPGA. Bahasa pengaturcaraan yang digunakan untuk projek ini adalah Verilog yang merupakan salah satu bahasa pengaturcaraan yang di gunakan oleh FPGA. Perisian yang digunakan untuk menulis bahasa pengaturcaraan adalah Xilinx ISE. apabila aturcara telah lengkap, langkah seterusnya adalah simulasi terhadap tingkah laku projek tersebut. Simulasi untuk system ini dijalankan pada perisian Model SIM PE Student Edition”. Apabila semua pengaturcaraan lengkap, system ini akan di laksanakan pada Xilinx Spartan II FPGA.

Projek ini akan membina sebuah lif berasaskan bangunan 10 tingkat. Lif ini akan bergerak keatas dan kebawah bergantung kepada permintaan pengguna. Dengan menggunakan FPGA, keputusan sepatutnya adalah, system akan lebih mudah di naik taraf disebabkan oleh kebolehan memilih pin sendiri pada FPGA. oleh yang demikian, sekiranya lif tersebut memerlukan lebih tingkat, ia akan lebih mudah untuk di bina semula.



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## LIST OF ABBREVIATION

DF	-	Destination Floor
DS	-	Elevator Door Sensor
FPGA	-	Field Programmable Gate Array
HDL	-	Hardware Description Language
INT	-	Initial State of Elevator
LED	-	Light Emitting Diode
LS	-	Elevator Limit Sensor
NCD	-	Native Circuit Description
NGD	-	Native Generic Database
PLC	-	Programmable Logic Controller
RF	-	Request Floor
RTL	-	Register Transfer Level
VHDL	-	VHSIC Hardware Description Language
VHSIC	-	Very-High-Speed Integrated Circuits

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## **CHAPTER I**

### **INTRODUCTION**

#### **1.1 Project Background**

The project is Design and Implementation of Elevator Controller on a Field Programmable Gate Array (FPGA). This project is to design an elevator controller that can be use at any elevator system. This design is to replace the current system that uses solid-state microprocessor to control the elevator.

Elevator was build to help the people to moving from one floor to another without consume a lot of people energy. With elevator people can move faster to higher floor. Elevator controller is a device that controls the movement of the elevator. Each request from each floor will go to the controller before is start command the elevator to move. The controller will control the entire request from floor, elevator door, emergency call and the up/down movement of the elevator.

Different building have different elevator. Elevator controller will depend on elevator design, higher building will need a complex controller compare to small building with low number of floor. In my project I only focus on to design an elevator controller base on 10 floor building with one elevator.

## **1.2 Project Objectives**

The objectives of this design are:

- i. To design and implement of elevator controller in a FPGA
- ii. To interface for the overall system according to the real elevator traffic algorithm with simple I/O interface on FPGA board

## **1.3 Problem Statement**

The previous system of the elevator controller is solid state microcontroller. The solid state microcontroller is hard to design because the solid state microcontroller is fixed to the manufacture and the designer need to follow the pin configuration. Beside the program of solid state microcontroller is hard to upgrade and the FPGA is more easy to upgrade. If the solid state microcontroller is used, the design will need more than one chip to perform the process. If the FPGA is use the controller will be only one chip for the whole system.

## 1.4 Scope of Work

This project is to design and simulate an elevator controller on a FPGA. Software of Xilinx ISE Design Suite is used for designing part and ModelSim for simulating this system. The elevator controller is control for 10 floor building that can be use for 24 hours. This design takes into some elements, it is elevator gate, the display for each level at the inside and outside elevator and floor request. The scopes of work are:

- i. 10 floor building with 1 elevator
- ii. Verilog as the program language
- iii. Use simple I/O interface on FPGA board
- iv. Xilinx and Model SIM for built the program and Xilinx Spartan 2 FPGA board

## 1.5 Methodology

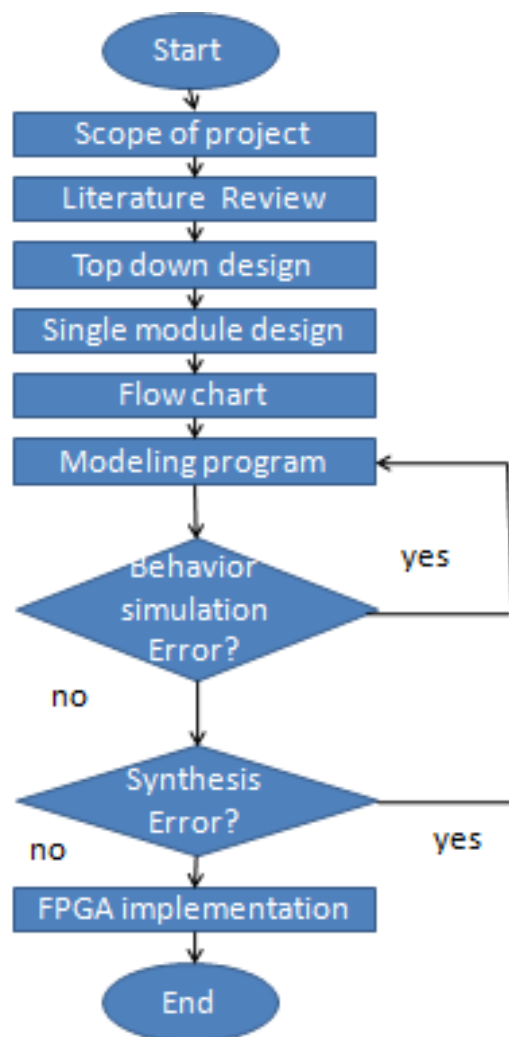


Figure 1.1: Methodology Flow Chart

Figure 1.1 shows the flow chart of the methodology to finish the project. From the finding scope of the project until the FPGA implementation. This topic will be explaining more detail in chapter III.

## 1.6 Report Structure

In this chapter, the report has explained about the background of the project. This chapter also has state the objective of the project and the problem statement. It also discuss about the structure of the methodology that will clearly explain in chapter 3. In this chapter, it also has state the scope of the project and how the project will design and implement.

In the second chapter, this report will clearly discuss the literature review of the project. This chapter will discuss how elevators work. The movement of elevator will be review in this chapter. This section also will discuss about the Field Programmable Gate Array (FPGA). The function and the advantage of use FPGA will clearly state in this section. In the last part of the chapter it will review some recent project about elevator.

The third chapter is methodology. This chapter will explain about the detail procedures that used to complete the project. From the finding the scope of the project until the design programming will elaborate more on this chapter.

The fourth chapter is the result and discussion of the project. This chapter will show all the result for the simulation and during the implement on the FPGA board. The result will be discussed in this chapter to explain the detail of the result and the error of the result that occur during the project.

In the last chapter, this report will give conclusion to the project and some recommendation for the future research. This chapter will include the conclusion of the project's objective and the achievement of the project during one year of project running.

## **CHAPTER II**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

This chapter will discuss about literature review of the project. Literature review is a summary of the research of this project. In this chapter, it will clearly state what is elevator, how elevator work and explain about other thing relate to this project.

This chapter are important to the project, all research relate will be discuss in this chapter. Beside, this chapter also will make the project clearly explain. How the project work, advantage and disadvantage of the project compare to the other system.