

## TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	<b>ABSTRACT</b>	<b>v</b>
	<b>LIST OF TABLES</b>	<b>xv</b>
	<b>LIST OF FIGURES</b>	<b>xvii</b>
	<b>LIST OF ABBREVIATIONS</b>	<b>xxi</b>
<b>1</b>	<b>INTRODUCTION TO LOW POWER VLSI DESIGN</b>	<b>1</b>
1.1	INTRODUCTION	1
1.2	OVERVIEW OF VLSI	2
1.2.1	Dealing With VLSI Circuits	3
1.2.2	VLSI Design Process	4
1.3	INTERCONNECT	5
1.3.1	Requirements of an Interconnection	
	Materials	7
1.3.2	Interconnect Resistance	7
1.3.3	Interconnect Capacitance	9
	1.3.3.1 Area capacitance	10
	1.3.3.2 Mutual coupling capacitance	10
	1.3.3.3 Fringe capacitance	10
1.4	BUS MODEL	11
1.4.1	Lumped RC Model	11
1.4.2	Distributed RC Model	13
1.5	POWER ESTIMATION	14
1.5.1	Estimation of $C_{in}$	15
1.5.2	Parasitic Capacitance	16

<b>CHAPTER NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
	1.5.3 Wiring Capacitance	16
	1.6 DATA COMPRESSION	16
	1.7 DATA CODING	18
	1.8 HAMMING DISTANCE ESTIMATOR	18
	1.9 MOTIVATION	18
	1.10 OBJECTIVE OF THESIS	21
	1.11 ORGANISATION OF THESIS	22
<b>2</b>	<b>LITERATURE REVIEW</b>	<b>23</b>
	2.1 INTRODUCTION	23
	2.2 DATA COMPRESSION	23
	2.3 DATA CODING	30
	2.3.1 Coding Scheme for Reduction of Power Dissipation	30
	2.3.2 Coding Scheme for Reduction in Self and Coupling Transition	37
	2.4 HAMMING DISTANCE ESTIMATOR	44
	2.5 CONCLUSION	51
<b>3</b>	<b>PRINCIPLES OF DATA COMPRESSION TECHNIQUES</b>	<b>53</b>
	3.1 INTRODUCTION	53
	3.2 FUNDAMENTALS OF COMPRESSION TECHNIQUES	53
	3.2.1 Advantages of Data Compression	54
	3.2.2 Disadvantage of Data Compression	54
	3.3 CLASSIFICATION OF COMPRESSION TECHNIQUES	55

<b>CHAPTER NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
3.4	LOSSLESS COMPRESSION	56
3.4.1	Entropy Based	56
3.4.1.1	Run length coding	56
3.4.1.2	Huffman coding	57
3.4.1.2.1	Limitations of huffman coding	59
3.4.1.3	Arithmetic coding	59
3.4.1.3.1	Limitations of arithmetic coding	63
3.4.2	Dictionary Based	63
3.4.2.1	Lempel ziv algorithms	64
3.5	PROPOSED METHOD	68
3.5.1	Simple byte compression algorithm	69
3.5.2	Simple byte decompression algorithm	71
3.6	RESULTS AND DISCUSSIONS	74
3.6.1	Bits per character	74
3.6.2	Analysis of Compression ratio and Compression factor	76
3.6.2.1	Compression ratio	76
3.6.2.2	Compression factor	77
3.6.3	Saving percentage	80
3.7	CONCLUSION	81
<b>4</b>	<b>DATA CODING TO MINIMIZING TRANSITION ACTIVITY</b>	<b>83</b>
4.1	INTRODUCTION	83
4.2	BUS ENERGY MODEL	83

<b>CHAPTER NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
4.3	TRANSITION ACTIVITY	85
	4.3.1 Self Transition	86
	4.3.2 Coupling Transition	86
4.4	BASICS OF DATA CODING TECHNIQUE	87
4.5	PROPOSED MULTI CODING TECHNIQUE	88
	4.5.1 Algorithm of Multi coding scheme	88
4.6	BLOCK DIAGRAM OF PROPOSED MULTI CODING TECHNIQUE	90
4.7	WORKING PRINCIPLE OF HAMMING DISTANCE ESTIMATOR	91
4.8	RESULTS AND DISCUSSIONS	94
	4.8.1 Transition Count	95
	4.8.2 Comparison of Transition count	99
	4.8.3 Energy Saving	100
4.9	CONCLUSION	102
<b>5</b>	<b>POWER MODELING AND ESTIMATION TECHNIQUES</b>	<b>103</b>
5.1	INTRODUCTION	103
5.2	NEED FOR LOW POWER DESIGN	103
5.3	LOW POWER DESIGN METHODOLOGY	104
	5.3.1 Power reduction through process technology	104
	5.3.2 Power reduction through circuit / Logic design	105
	5.3.3 Power reduction through Architectural design	106
	5.3.4 Power reduction through algorithm	106

<b>CHAPTER NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
	5.3.5 Power reduction through system integration	107
5.4	<b>POWER MODELING</b>	107
	5.4.1 Static power dissipation	108
	5.4.2 Dynamic power dissipation	108
	5.4.2.1 Switching Power	109
	5.4.2.2 Internal Power	109
5.5	<b>DESIGN PARAMETER</b>	112
	5.5.1 Two dimension design flow	112
	5.5.2 Three dimension design flow	113
5.6	<b>POWER ESTIMATION TOOL</b>	116
	5.6.1 Non Power Tool	117
	5.6.1.1 Simulation Tool	117
	5.6.1.2 Synthesis Tool	117
	5.6.1.3 Area output	118
	5.6.1.4 Delay output	119
	5.6.2 Power Tool	119
	5.6.2.1 XPower Analysis Tool	120
5.7	<b>CONCLUSION</b>	122
<b>6</b>	<b>HAMMING DISTANCE ESTIMATOR USING PASS TRANSISTOR LOGIC</b>	<b>123</b>
	6.1 INTRODUCTION	123
	6.2 PASS TRANSISTOR LOGIC	124
	6.2.1 NMOS Pass Transistor	125
	6.2.2 PMOS Pass Transistor	126
	6.3 ARITHMETIC ADDER	127
	6.4 DIFFERENT LOGIC DESIGN ADDER	128

<b>CHAPTER NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
6.4.1	Conventional static CMOS logic full adder	128
6.4.2	Static differential cascode voltage switch logic full adder	129
6.4.3	Dual rail domino logic full adder	129
6.4.4	Double pass transistor logic full adder	130
6.4.5	Static differential split level logic full adder	131
6.4.6	Dynamic differential cascode voltage switch logic full adder	132
6.4.7	Complementary pass transistor logic full adder	133
6.5	<b>RESULTS AND DISCUSSIONS</b>	134
6.5.1	Comparison of different CMOS logic design	135
6.5.2	Transistor count	136
6.5.3	Power dissipation	137
6.5.4	Propagation delay	138
6.5.5	Area	140
6.6	<b>SIMULATION RESULT</b>	141
6.7	<b>CONCLUSION</b>	141
<b>7</b>	<b>CONCLUSION</b>	<b>143</b>
7.1	CONCLUSION	143
7.2	FUTURE SCOPE	145
	<b>REFERENCES</b>	<b>146</b>
	<b>LIST OF PUBLICATIONS</b>	<b>157</b>