DESIGN OF AN IMPROVED FUZZY CONTROLLER MICROCHIP FOR WASHING MACHINE

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Engineering

in

Mechatronics

at

Massey University,

Auckland, New Zealand

Pritesh Lohani

May 2010

ABSTRACT

Washing machines are today a common household requirement. Wash time is one of the key factors that need to be taken into account in a design of a washing machine. Washing machines which do not use fuzzy controller serves most purposes of washing function but wash time is somewhat not dealt properly.

This study describes the full architectural (both circuitry and physical layout) design of an improved washing machine controller microchip that uses fuzzy logic approach to specifically deal with the wash time in a much more efficient manner. Recent research shows that fuzzy logic approach responds much faster than any other conventional technique. This fuzzy logic controller microchip for washing machine has 36 Input/Output (I/O) pins including two Vdd and two Vss. On chip fuzzification, Fuzzy Inference Engine, Defuzzification, ROM-based Fuzzy sets and MIN-MAX array-based Fuzzy rules are the salient features of the design.

With full Complementary Metal Oxide Semiconductor (CMOS) interface, it is suitable as a co-processor.

ACKNOWLEDGEMENTS

I cannot stress the fact that the single most important person contributing to student's success is the supervisor. It is important to pick an advisor who is both interested and knowledgeable in the chosen research area. With this in mind, I would like to express my deepest gratitude and sincerest appreciation to Dr. S M Rezaul Hasan for his supervision, enthusiastic guidance and continuous encouragement throughout the course of study. Dr. Hasan's extensive knowledge of circuits and keen insight into VLSI design were major assets.

I am also thankful to my sister Priti Lohani; and my friends Nooriyah Poonawala, Mahoda Ratnayaka, Cao Van Pham, Jack Li and Mohammad Khurram for assisting in many ways.

Last but not least, very special thanks go to my parents for their emotional support and advice throughout all my achievements in life.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

ASIC: Application Specific Integrated Circuit

CMOS: Complementary Metal Oxide Semiconductor

CLK: Clock

CLR: Clear

DRC: Design Rule Checker

EDA: Electronic Design Automation

I/O: Input/Output

LI: Linguistic Input

LO: Linguistic Output

MAX: Maximum

MIN: Minimum

NGT: Negative Transition (of the clock)

PGT: Positive Transition (of the clock)

LIFE: Laboratory for International Fuzzy Engineering

LSB: Least Significant Bit

MSB: Most Significant Bit

MOD-13: Modular 13

OE: Output Enable

ROM: Read Only Memory

SPICE: Simulation Program with Integrated Circuit Emphasis

T-SPICE: Tanner Simulation Program with Integrated Circuit Emphasis

US: United States of America

VLSI: Very Large Scale Integration