UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT OF SOFTWARE SYSTEM FOR DETECTING DEFECTIVE SYMBOL ON IC CHIP USING MATROX IMAGING LIBRARY

MAASPALIZA AZRI.

DEVELOPMENT OF SOFTWARE SYSTEM FOR DETECTING DEFECTIVE SYMBOL ON IC CHIP USING MATROX IMAGING LIBRARY

By

MAASPALIZA AZRI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

March 2004

Dedicated to my parents,
Muhidan Mohd Natar and Fatimah Osman

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

DEVELOPMENT OF SOFTWARE SYSTEM FOR DETECTING DEFECTIVE SYMBOL ON INTEGRATED CIRCUIT CHIP USING MATROX IMAGING LIBRARY

By

MAASPALIZA AZRI

March 2004

Chairman: **Associate Professor Ishak Aris, Ph.D.**

Faculty: **Engineering**

In semiconductor fabrication process, symbol or label inspection is one of the main processes that needs to be considered seriously. Errors may occur during the printing process of label or name on the integrated circuit chip (IC). If this occurs, the IC chip may have a wrong name. This will affect the credibility of the company who produces the IC chips. The problem mentioned above can be solved by providing a reliable detection system that is able to detect the errors printed on the IC chip.

The symbol detection system that currently being implemented by the semiconductor industry suffers from overkilled and escapes problems. This project presents the development a software system, which capable of detecting the defective characters printed on the IC chip using Active Matrox Imaging Library Release 7. The proposed

system has an adjustable reading level that can solve the overkilled and escaped problems. It consists of a graphical user interface module, an inference engine, an image database, an ActiveMIL ActiveX control module, a Matrox Imaging Library module, an input image, and an output image. The proposed system is written in Visual Basic version 6 and it is interfaced with Active Matrox Imaging Library.

The proposed system also has learning capability. It can store up to two different IC images at one time. The system was designed for off-line operation. The test results demonstrated that the proposed system performs according to its functions. It achieves 100% detection rate.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

MEMBINA PROGRAM SISTEM PERISIAN UNTUK MENGESAN KESALAHAN SIMBOL PADA CIP LITAR BERSEPADU DENGAN MENGGUNAKAN "MATROX IMAGING LIBRARY"

Oleh

MAASPALIZA AZRI

Mac 2004

Pengerusi: **Profesor Madya Ishak Aris**

Fakulti: **Kejuruteraan**

Pemeriksaan label atau symbol pada cip litar bersepadu merupakan satu process penting yang perlu dititikberatkan di dalam proses fabrikasi semikonduktor. Sepanjang proses fabrikasi terdapat kemungkinan berlaku kesilapan mencetak label atau symbol pada cip litar bersepadu. Kesilapan mencetak pada litar bersepadu akan menyebabkan cip berkenaan menpunyai nama yang salah dan ini akan memberi kesan kepada kredibiliti syarikat pengeluar cip tersebut. Walaubagaimanapun, masalah ini dapat di atasi dengan menggunakan sistem pengesan yang dibina untuk mengesan kesalahan melabel atau mencetak simbol pada cip litar bersepadu.

Sistem pengesanan simbol yang sedia ada di dalam pasaran industri semikonduktor sekarang tidak bergitu berkesan kerana sistem tersebut tidak dapat membezakan di antara cip litar bersepadu yang boleh diterima pakai dengan cip yang rosak semasa

proses pengesanan. Projek ini mempersembahkan pembinaan sistem perisian yang mampu mengesan kesalahan mencetak simbol pada cip litar bersepadu dengan menggunakan 'ActiveMIL Release 7'.

Di dalam sistem cadangan ini terdapat kesesuaian tahap bacaan bagi sesuatu imej litar bersepadu, di mana kesesuaian ini dapat menyelesaikan masalah untuk membezakan di antara cip litar bersepadu yang boleh diterima pakai atau tidak semasa process pengesanan. Sistem cadangan ini mengandungi hubungan antara grafik dengan pengguna, kewarasan enjin, butiran maklumat imej, modul kawalan 'ActiveMIL ActiveX', modul 'MIL', bahagian kemasukan imej dan bahangian keluaran imej. Sistem cadangan ini ditulis dalam 'Visual Basic Version 6' dan ia dihubung dan disambungkan dengan 'ActiveMIL'.

Sistem ini juga mengandungi kebolehan untuk memperolehi maklumat daripada proses pembelajaran. Dua jenis imej cip litar bersepadu yang berbeza untuk dianalisis boleh disimpan pada masa yang sama. Keputusan ujian menunjukkan bahawa sistem yang dibina ini dapat melaksanakan proses pengesanan simbol pada cip litar bersepadu dengan efektif dan sistem ini boleh mencapai kadar pengesanan sebanyak 100%.

ACKNOWLEDGEMENTS

First of all, I would like to thank my Lord, Allah S.W.T for giving the courage to complete this project on time.

Extra special thanks go to my supervisor, Professor Madya Dr. Ishak Aris for all the support and guidance to me in finishing this project. Thanks also to my project's supervisory committee, Professor Marzuki Khalid and Mr. Khair Hassan

I would like to extend my deepest gratitude to Mr. Nik Zainuddin and Mr. Fairus for their awesome suggestions and advices. May we all be successful on our ventures!

Thanks also to my dearest parents, Fatimah Osman, Muhidan Mohd Natar and all my family members Muzalifah, Mohd. Azlan and Mohd Azli. No words can express my gratitude and love for all.

I would like to thank my colleague, Miss Zainab Hassan and my friend Miss Rabizah Ibrahim. And also my dearest fiancée, Mr. Nazarul Abidin Ismail for all the love and supports. Without their perseverance and patience, I would not have been able to achieve, what I achieved today.

Thanks also to Prof. Shamsudin Haji Mohd Amin, Texas Instrument and all the members of the VSDP group for providing the supports through out the project.

Last but not least, I would like to thank the Ministry of Science Technology and Environment for providing the financial support through IRPA Project entitled "Design of Intelligence Vision Inspection System for Quality Control in Semiconductor Industry (Project #: 03-02-06-0051 PR02204-02).

I certify that an Examination Committee met on 19th March 2004 to conduct the final examination of Maaspaliza Azri on her Master of Science thesis entitled "Development of Software System for Detecting Defective Symbol on IC Chip Using Matrox Imaging Library" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

S. S. Jamuar, Ph.D.
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Samsul Bahari Mohd. Noor, Ph.D.
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Abd. Rahman Ramli, Ph.D.
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Nasir Taib, Ph.D.
Associate Professor
Faculty of Electrical Engineering
Universiti Teknologi MARA Malaysia
(Independent Examiner)

GULAM RUSUL RAHMAT ALI, Ph.D.
Professor/Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

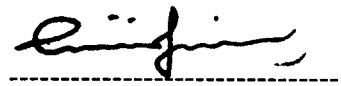
Date: 17 JUN 2004

This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfillment of the requirement for the degree of Master of Science. Members of the Supervisory Committee are as follows:

Ishak Aris, Ph.D.
Associate Professor
Department of Electrical and Electronics Engineering
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Marzuki Khalid, Ph.D
Professor
Department of Electrical and Electronics Engineering
Faculty of Engineering
Universiti Putra Malaysia
(Member)

Mohd Khair Hassan, Master
Lecturer
Department of Electrical and Electronics Engineering
Faculty of Engineering
Universiti Putra Malaysia
(Member)



AINI IDERIS, Ph.D.
Professor/Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 09 JUL 2004

DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM other institutions.

MAASPALIZA AZRI

Date : 15 JUN 2004 .

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Introduction

The character recognition system has many applications. These include license car plate number verification (Yamanguchi, et al., 1999), verification of postcodes in handwritten and hand-printed addresses (Kabir, et al., 1990), money transfer forms and cheques used by banks (Miletzki, 1997), etc. In semiconductor fabrication process, symbol or marking inspection is one of the main processes that needs to be considered seriously.

Symbol or marking inspection algorithms have changed very little since their introduction onto the semiconductor industry in the late 80's. On the contrary, customers' quality requirements have increased many folds. They will no longer tolerate the packing errors such as wrong symbol printed on the IC, unclear characters on IC, etc. At the same time, manufacturers face the problems of overkilled or escaped IC chip. The current inspection system cannot solve the overkilled and escaped problems. Overkilled event occurs when the inspection system rejects the IC, which has a minor error printed on the IC chip. The characters printed on the IC chip can still be read with bare human eyes. However, if this problem is not rectified, the manufacturer will lose its profits. Meanwhile, the escaped event will occur when the inspection system is unable to detect the error printed on the IC chips. This problem will cause the manufacturer to lose its customers because the manufacturer provides wrong or defective IC chips.