UNIVERSITI PUTRA MALAYSIA

DEVELOPMENT OF AN AUTOMATED BOOK CASING FOR IC INDUSTRY

CHONG KOK HEN

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By

CHONG KOK HEN

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

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Dedicated to my parents Chin Hwa and Choon Far,
and
my wife Kheng Siew

With Love... ...

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

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June 2002

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Faculty : Engineering

Today, most of the IC industries are using fully automatic machines to perform the process of placing the casing onto the IC. With high technology machines, daily production can be increased. However, the cost of those machines are extremely high. Therefore, the small and medium scale industries are unable to purchase these machines. In order to over come this problem, an inexpensive automatic book casing system is proposed and developed.

The main objective of this project is to design a low cost machine with safety features, fully automatic and a user-friendly. This machine should be able to perform the application such punching and stamping the casing of the Integrated Circuit (IC) as well as pick and place application.

The structure design of this project is separated into two parts. They are the hardware construction and the software development. The hardware part involves the design and construction of an input station, an output station, a conveyer station, a pick and place robotic arm, a punching station, a pressure faulty detection system, a power distribution module, a pneumatic control system and data logger module.

The software part involves the design and development of the system control software. The system control software is created by using FPSOFT PLC programming software. FPSOFT can create the PLC programming more effectively because it uses the graphic symbol to create the PLC ladder diagram. FPSOFT is also efficient in terms of trouble shooting and programming modification.

This project implements the Matsushita NAIS FP0 Programmable Logic Control (PLC) to control the overall system of the machine. FP0 is a simple and user friendly controller. FP0 can extend its I/O port to 128 units for large number of input and output devices control.

The proposed project was successfully designed, constructed and tested. It is also working and functioning accurately as planned in its design stage. This can be shown from the experimental results conducted on the system.

Abstrak tesis yang dikemukakan kepada Senat University Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Master Sains

PEMBINAAN PENUTUP AUTOMATIK UNTUK INDUSTRI LITAR BERSEPADU

Oleh

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Pada masa kini, kebanyakan industri litar bersepadu menggunakan mesin automatik untuk melakukan proses meletakan penutup pada litar bersepadu. Degan mesin berteknologi tinggi ini, produktiviti harian dapat ditingkatkan. Walaubagaimanapun, kos untuk mesin terbut adalah terlalu tinggi. Oleh itu, industri yang kecil dan serdahana tidak mampu membeli mesin tersebut. Untuk mengatasi masalah ini, sebuah sistem penutup automatik kos rendah telah dicadang dan dibina.

Objektif utama projek ini ialah merekabentuk sebuah mesin yang berkos rendah, berciri-ciri keselamatan, automatik sepenuh dan mudah digunakan. Masin ini sepatutnya dapat melakukan applikasi seperti menubuk penutup pada litar bersepadu dan applikasi "pick dan place".

Struktur rakabentuk projek ini boleh dibahagikan kepada dua bahagian iaitu perkembangan perkakasan dan perkembangan perisisan. Bahagian perkembangan perkakasan meliputi rekabentuk dan pembinaan untuk stesen masukan, stasen keluaran, stesen konvayer, lengan robotik 'pick and place', stesen penebuk, sistem pengesan kecacatan kuasa penekanan, model penghantaran kuasa, sistem pengawal kuasa pneumatik dan model pencatitan data.

Bahagian pengembangan perisian meliputi rekabentuk dan pembangunan untuk perisian pengawalan sistem. Perisian pengawalan sistem ini dicipta dengan menggunakan FPSOFT. FPSOFT boleh mencipta perisian PLC dengan berkesan kerana ia menggunakan simbol grafik untuk mencipta diagram tangga PLC. FPSOFT juga berkesan dalam pengesanan masalah dan perubahan perisian PLC.

Projek ini menggunakan Pengaturcara Kawalan Logic (PLC) model Matsushita NAIS FP0 untuk mengawal keseluruhan sistem bagi mesin ini. FP0 adalah sebuah pengawal yang simple dan mudah dioperasi. FP0 boleh menambahkan 'port' masukan and keluarannya (I/O port) sehingga 128 unit untuk pengawalan alatan masukan dan keluaran dalam jumlah yang lebih banyak.

Objektif bagi projek telah berjaya direkabentuk, dibina dan diuji. Ia juga berfungsi dengan tepat seperti yang dirancang. Ini dapat dilihat pada keputusan eksperimen yang dilakukan pada sistem tersebut.

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This thesis submitted to the Senate of Universiti Putra Malaysia has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the supervisory committee are as follows:

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LIST OF ABBREVIATIONS

C	Center Distance
CAD	Computer Aid Design
CAM	Computer Aid Manufacturing
CPU	Central Processing Unit
CRT	Cathode Ray Tube
D	Pitch Diameter
DC	Direct Current
EMR	Electromagnetic Radiation
F	Force
FRL	Filter Regulator Lubricator
F_{th}	Theoretical Piston Force
g	Gravitation Acceleration
GUI	Graphic User Interface
I	Current
I_A	Motor Armature Current
IC	Integrated Circuit
I_F	Motor Field Current
I_L	Motor Load Current
I/O	Input and Output
L	Belt Length
LED	Light Emitting Diode
m	Mass

mA	Miliampere
n_1	Number of teeth on driving sprocket
n_2	Number of teeth on driven sprocket
N_1	rpm of driving shaft
N_2	rpm of driven shaft
NC	Normally Close
NO	Normally Open
PC	Personal Computer
P_{CM}	Conveyer Motor Power Consumption
P_{CONV}	Power Converted
Pi	Input Power
P_{IMFL}	Full Load Input Motor Power Consumption
P_{IMNL}	No Load Input Motor Power Consumption
P_L	Dissipated Power
PLC	Programmable Logic Control
P_o	Output Power
P_T	Total Power Consumption
P_{TFL}	Full Load Total Power Consumption
P_{TNL}	No Load Total Power Consumption
r	Distance
R_{adj}	Motor Armature Resistance
R_h	Motor Terminal Resistance
R_F	Motor Field Resistance
ROM	Read Only Memory

RPM	Renovate Per Minute
V	Voltage
VAC	Alternative Current Voltage
VDC	Direct Current Voltage
T	Torque
τ_{ind}	Induce Motor Torque
T_o	Motor Output Torque
μ	Coefficient Friction
VR	Velocity Ration
ω	Speed
w	Weight
θ	Angle Subtended with the Horizontal

CHAPTER 1

INTRODUCTION

1.1 Introduction

Today, most of the IC industries are using fully automatic machines to perform the process of placing the casing onto the IC. With the high technology machines, daily productivity can be increased. However, the costs of these machines are extremely high. As a result, the small and medium scale industries are unable to purchase these machines. In order to overcome this problem, an inexpensive automatic book casing system is proposed and developed. This system consists of electrical and mechanical components. The block diagram of the system is shown in Figure 1.1. It uses PLC as its main controller to control the operation of the entire system. Other main components used in this system includes conveyer belts, DC motor, pneumatic valve, sensors, counter, air cylinder, limit switches, air compressor, and a power distributor module.

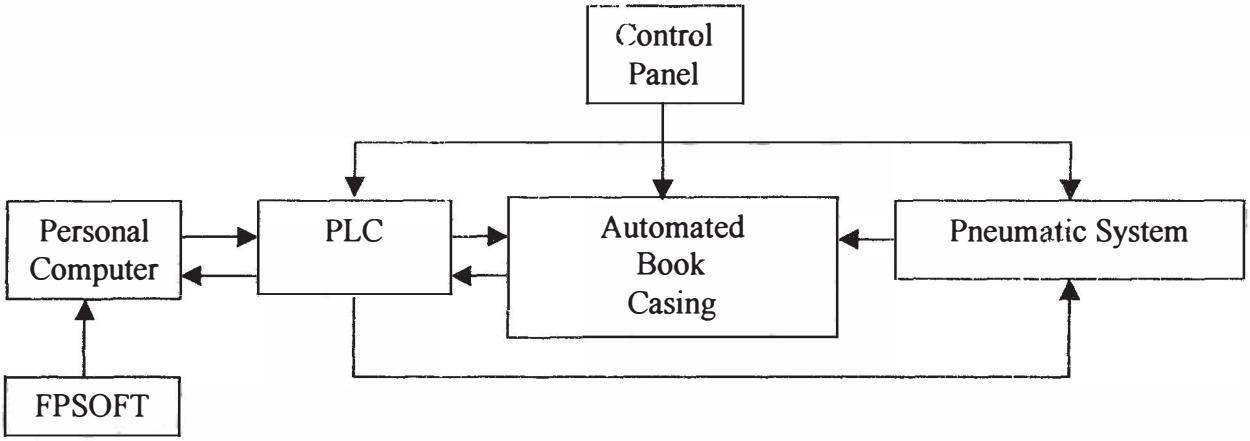

Figure 1.1: Block Diagram of the Proposed System

The process involved in the fabrication of the IC is depicted in Figure 1.2. The process can be divided into six steps. The first step deals with the layout design of the IC. The layout design of the IC is then transferred to the wafer in the second step. The third step is a process that separates the individual die from the wafer. The wire bonding process of the die is conducted in the fourth step. The fifth step involves the process of putting the case onto the die of the IC. The encryption process is conducted in the final step

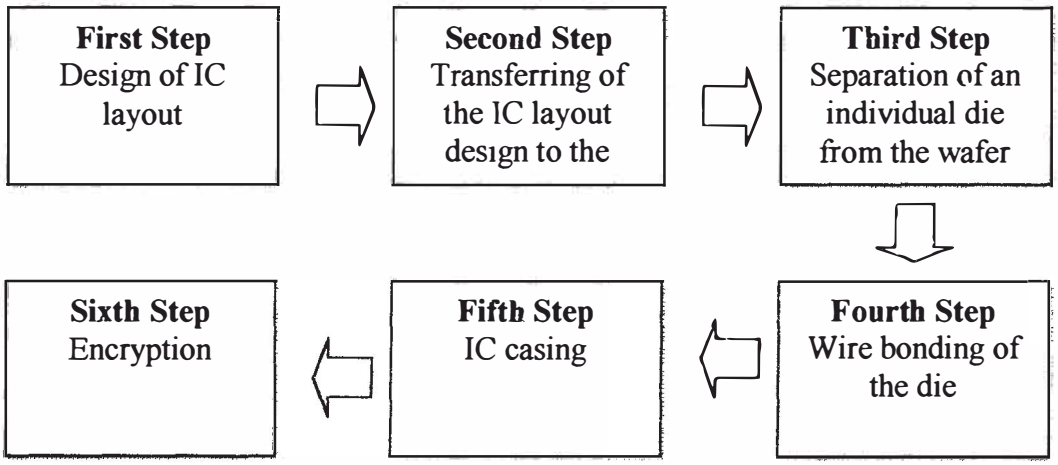

Figure 1.2: IC Fabrication Process

The proposed system involves the fifth step of the fabrication of the IC The function of this system is to put the case onto the die automatically after the wire bonding process

This project used the concept of Computer Integrated Manufacturing (CIM) in terms of monitoring, controlling as well as data collecting CIM is commonly thought of as an integrated system that encompasses all the activities in the production system, from the planning to the designing of a product through the manufacturing system

Briefly, the project consists of hardware design, construction, testing and software development

As shown in Figure 1 3, the configuration of the project can be divided into two parts - the hardware and the software The hardware part constitutes two modules, namely the control panel and the basic structure of the project The control panel consists of PLC, power supply and pneumatic control valves The function of the control panel is used to control the overall system The basic structure of the project comprises of up and down loading system, cylinders and various types of sensors

The software part includes the PLC programming language As shown in Figure 1 3, the PLC programming emphasizes the configuration of the ladder diagram, I/O mapping and serial communication interface Figure 1 4 illustrates the basic structure of the proposed system

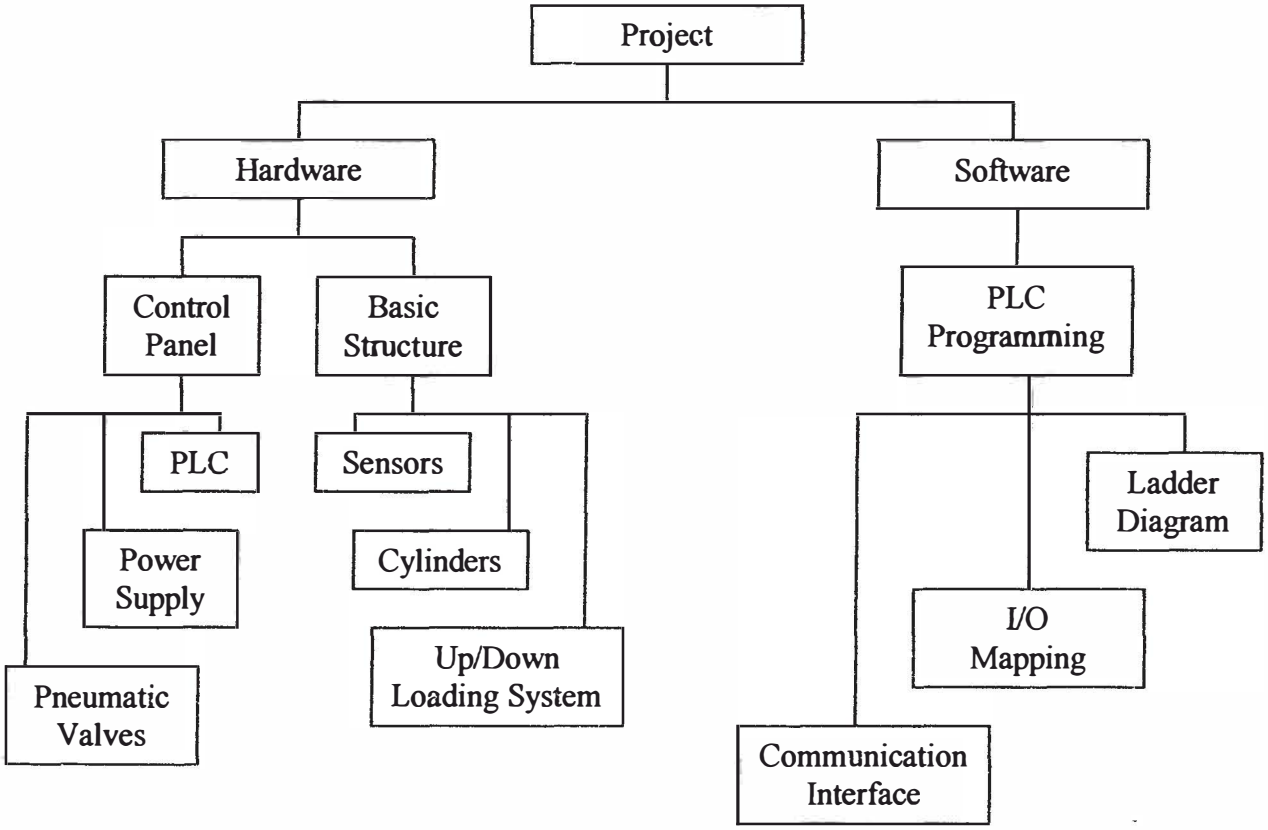

Figure 1.3: Project Overview