

ANALYSIS ON THE ROBOTICS CHIP MOUNTER  
PERFORMANCE

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA  
2014



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**ANALYSIS ON THE ROBOTICS CHIP MOUNTER  
PERFORMANCE**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics & Automation) (Hons.)

by

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# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

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## **APPROVAL**

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics & Automation) (Hons.). The member of the supervisory committee is as follow:

.....

Supervisor,  
Dr. Fairul Azni b Jafar

## ABSTRAK

Pada zaman yang serba canggih seiring dengan pembangunan yang pesat membangun, pelbagai peralatan yang canggih telah dihasilkan oleh pengilang yang mengejar zaman kecanggihan ini. Dengan ini, produk yang telah dikeluarkan adalah seperti telefon pintar, perubatan, alat komunikasi, komputer, kalkulator, peralatan automatif dan lain-lain lagi. Penghasilan produk ini adalah daripada peralatan yang pintar iaitu *Printed Circuit Board (PCB)*. *PCB* dihasilkan melalui industri dalam bidang *Surface Mount Technology (SMT)*. Dengan ini, dalam industri *SMT* terdapat pelbagai proses dalam menghasilkan produk, antaranya pemanasan “substrate”, percetakan pateri, pelekap cip, pengeringan dan pencucian dengan menggunakan 6 tangki. Jadi, masalah ini dianalisis hanya fokus pada proses pelekap cip, di mana mempunyai masalah semasa proses pengeluaran. Projek ini dihasilkan bagi mengkaji kecekapan masa dan masalah yang telah berlaku pada *PCB* yang telah dilekapkan komponen pada papan *PCB*. Kaedah yang digunakan untuk mengkaji masalah ini adalah dengan menggunakan kaedah *Design of Experiment (DOE)*. Kaedah ini melibatkan proses pengumpulan data masa pada mesin pelekap cip. Masa diambil pada pelbagai jenis komponen dan satu mesin. Ini kerana, didapati masalah sering berlaku pada mesin ini di lorong keempat dalam kilang yang telah menjalani latihan industri. Proses melekapkan komponen pada papan *PCB* adalah satu proses yang penting dalam industri *SMT*. Jika proses melekapkan komponen pada papan *PCB* mempunyai pelbagai masalah maka, papan *PCB* tidak dapat berfungsi dengan betul dan secara tidak langsung akan mengurangkan kualiti industri semikonduktor. Setelah mendapatkan data masa, data ini dianalisis dengan menggunakan proses

*Ishikawa* (diagram tulang ikan). Analisis turut dibuat dengan mengkaji tenaga kerja, mesin, kaedah dan bahan bagi melihat punca masalah. Dengan ini juga, mengkaji komponen dan sarung komponen yang bermasalah. Akhir sekali, cadangan bagi mengurangkan masalah ini berlaku adalah dengan menambah sistem penglihatan pada mesin untuk mengesan komponen yang rosak sebelum menjalani proses melekapkan cip.

## **ABSTRACT**

In very sophisticated era in line with rapid development, various advanced equipments have been produced by the manufacturer's pursuit of the sophistication of the time. With this, the products that has been manufactured such as smart phones, medical, communication devices, computers, calculators, automative equipment and others. Production of this product is from the smart appliance which is Printed Circuit Board (PCB). PCB manufactured by industry in the field of Surface Mount Technology (SMT). SMT industry consist of various processes involved in producing products such as substrate bake, solder printing, chip mounting, reflow and flonics 6 tanks. The problem analysis is focusing on the chip mounting process, which have problems during the production process. The main objective of this project to study the efficiency of time and problems that occurred on a PCB that was mounted with components. The method used to study this problem is by using Design of Experiment (DOE). This method involves the collection of data on the chip mouter machine. Time taken on a wide variety of components and the machine. It appears the problem often occurs on this machine in the fourth lane in factory when industrial training. The process of mounting the components on the PCB is an important process in the SMT. If the process of mounting the components on the PCB has a different problem, PCB cannot function properly and indirectly will reduce the quality of the semiconductor industry. After obtaining the data, the data were analysed by using Ishikawa diagram (fishbone diagram). The analysis was made by studying man, method, material and machine to see the root problem. Finally, suggestion for reducing this problem occurs is proposed in which it is to add



a machine vision system to detect components defect before undergoing place the components on the PCB board.

## **DEDICATION**

For my mother Siti Eshah bt Abdullah and my beloved family,

Their loving and unconditional support throughout my life.

Without whose love and supported this may not be completed.

And also who those I love very much.

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## **LIST OF ABBREVIATIONS**

- PCB - Printed Circuit Board
- SMT - Surface Mount Technology
- DOE - Design of Experiment
- FAP - Feeder Arrangement Problem
- PSP - Placement Sequencing Problem
- TSP - Travelling Salesmen Problem
- NP - Non-Polynomial
- QAP - Quadratic Assignment Problem
- PSO - Particle Swarm Optimization
- FMS - Flexible Manufacturing System
- DC - Direct Current
- IC - Integrated Circuit

# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Background**

Development of electronic industry is blooming in line with the development. Increased use of electronics to go global. The industry is getting fierce competition among manufacturers of electronic products. Sophisticated electronic to expand as a technology advanced era. Customer demand increased, then the development of technology production system to be effective and productive.

Most electronic products contain Printed Circuit Boards (PCBs) as the most important component. PCBs (see Figure 1.1) are used extensively in a variety of products such as computers, calculators, robots, remote control, cellular phones, controllers, automotive industrial and many other electronic instruments.

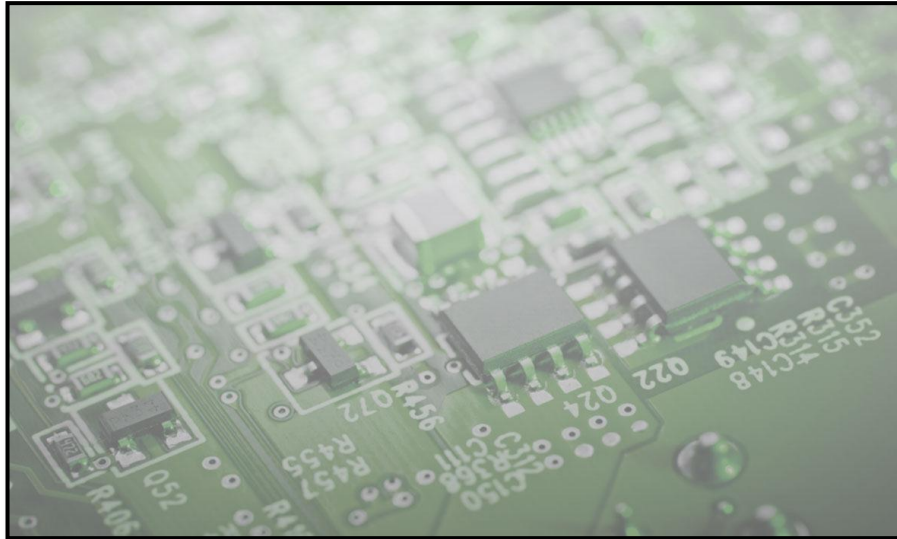


Figure 1.1: Example of Printed Circuit Board.

(Source: < <http://www.dreamstime.com/royalty-free-stock-photography-pcb-printed-circuit-board-3d-image14007547> >25/09/2013)

The assembly of PCBs is a complex task since a PCB may contain hundreds of electronic components in different shapes and sizes mounted at specific locations on the substrate. In the past, substrate assembly consist of inserting leads through holes in the board and then solder them into the place. Currently, Surface Mount Technology (SMT) is generally used in PCBs assembly. With SMT, components are attached to a bare substrate with solder paste at pre specified location. Then a reflow operation heats the substrate causing the solder paste to melt for the proper connections.

The beginning of process for surface mount technology is substrate bake that heat substrate from water vapour for about 5 hours. Solder paste will be wiped in stencil that was punched according to substrate size. Next is the process of chip mounting, where components are mounted in substrate or PCBs.

An SMT assembly line mounts the components at faster speeds and with higher precision. To complete the process of surface mount technology, six processes are required. Chip moulder is one of the main processes in surface mount technology. Chip moulder machine application in industry is so widespread and nowadays problems arose in PCB from the efficiency aspect as well as the machine speed.

## **1.2 Motivation**

Chip mounter is important in the process of SMT. In semiconductor industry, Integrated Circuit (IC) must be mounted and for that chip mounter machine is widely employed. In many cases, defect found on PCB analysis on the chip mounter machine is required in order to reduce defect in PCB and indirectly reduce cost of losses and increase product quality.

## **1.3 Problem Statement**

Efficiency in chip mounter machine movement in terms of nozzle and system for mounting component on PCBs, indeed was acknowledged. Time efficiencies in chip mounter machine used is not accordance to the time of system process for mounting component in substrate. Nozzle is important to be efficiently moved for chip mounter when carrying out the process.

In many SMT industries, there are defects in PCBs which caused by component missing and component misalignment. Defect which occurred will reduce PCBs quality for customer satisfaction.

## **1.4 Objective**

The objectives of this project are :

- i. To identify the cause of unstable production time and product defect on PCB assembly process.
- ii. To propose counter measure for the problems and causes.

## **1.5 Scope**

The scopes of this project will emphasis on conducting experimental analysis :

- i. Analysis on chip mounter machine is for one line selected which always come out with operational performance problems and product defect.
- ii. The study involve several type of PCBs mounted in the selected production line.

## **1.6 Report Structure**

This report is structured as follows :

Chapter 1 explain the introduction of chip mounter machine that efficient and quick in mounting component process and defect that happened in PCBs.

Chapter 2 consists of literature review study which describes the related works of chip mounter machine for industrial.

Chapter 3 describes the methodology used in this study including the overall flow chart the project.

Chapter 4 present the result and discussion on the chip mounter performances.

Chapter 5 is the conclusion that concludes the project by presenting the final outcome and achievement as well as future recommended works.

## **CHAPTER 2**

### **LITERATURE REVIEW**

This report is focusing on the chip mounter performances in SMT field. Section 2.1 of this report will explain in the introduction of chip mounter, section 2.2 will discuss about problem in process chip mounter, section 2.3 will explore methods use for optimization of chip mounter and 2.4 summary of this report.

#### **2.1 Introduction**

Kim, M.K and Park, H.P (2004) and Park, T.H and Kim, C.H (2000) states that the chip mounter is a dedicated robot system to assemble PCB in the SMT in- line system. Optimizing and automating the chip mounter is the important issue to increase the productivity of the line. Huseyin *et al.* (2010) defined that chip mounter consists of three parts, rotational turret, component magazine and board carrier. Responsible for the pickup of components from the components magazine and placing them on the PCB was done by process chip mounter when has a rotational turret consisting of multiple heads. Circular structure behind the machine and it is stationary was also called the component magazine where the component tapes are installed.