UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF MULTI LED MACHINE FIXTURE USING PNEUMATIC SYSTEM AND PLC

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours.

by

ONG CHEE SHEN

FACULTY OF MANUFACTURING ENGINEERING

2009

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Design and Analysis of Multi LED Machine Fixture Using Pneumatic System and PLC**

SESI PENGAJIAN: 2008/09 Semester 2

Saya **ONG CHEE SHEN**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (✓)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	TIDAK TERHAD	

Disahkan oleh:

_____ (TANDATANGAN PENULIS)

_____ (TANDATANGAN PENYELIA)

Alamat Tetap:
C-2-9, Bayu Tasik Condo 2,
Jalan Sri Permaisuri 5, 56000
Cheras, Kuala Lumpur

Cop Rasmi:

Tarikh: 10 APRIL 2009

Tarikh: _____

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled "Design & Analysis of Multi LED Machine Fixture Using Pneumatic System and PLC" is the results of my own research except as cited in references.

Signature	:	…….
Author's Name	:	ONG CHEE SHEN
Date	:	10 APRIL 2009

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) with Honours. The member of the supervisory committee is as follow:

……

(Main Supervisor)

(Official Stamp & Date)

ABSTRACT

In the 21st century, the LEDs become vast growing parts that replacing the signaling and lighting devices. The manufactures of LEDs play a major role for supporting vast amount of LEDs usage in various applications. The preparation of LEDs for production is important to reduce the total time consumption used. Preparation of LEDs using manual bending and cutting requires human labor that cost a lot of time and not reliable in terms on the bending and cutting quality of the lead using pliers and hand cutters. The main objective of producing this report is to improving the preparation of LEDs by designing a new concept of fixture that bend and cut multi LEDs simultaneously powered by pneumatic system and control by PLC. The progress of the project starts with the producing of 3 type's fixture concept sketch and to be evaluated by using the concept screening matrix method. The highest rank of evaluation will be selected for undergoes actual prototype design using solidworks design software and also PLC programing. Simulation can be done on solidworks to determine collision and error. The fabrications of fixture parts will be start base technical drawing publish using solidworks after the finest prototype simulation is retrieve. Fixture is then assembles and wired together with pneumatic and PLC system. Testing and analysis is run on the prototype to evaluate the capabilities of the fixture. The particular strength of this project is in providing new concept design for improving manufacturing of LED devices capability in automation industry.

Keyword: Machine fixture, LED, Concept Design, Pneumatic system, PLC.

ABSTRAK

Dalam abad ke-21, perkembangan LEDs menjadi meluas dalam menggantikan alat-alat isyarat dan alat-alat lampu. Teknologi pembuatan LEDs memainkan satu peranan yang penting untuk menyokong jumlah penggunaan LED yang luas dalam pelbagai aplikasi. Persediaan LED dalam pembuatan adalah penting untuk mengurangkan jumlah masa yang digunakan. Persediaan LED menggunakan manual pembengkokan dan pemotongan memerlukan tenaga manusia dan banyak masa malah menjejaskan kualiti pembengkokan dan pemotongan kaki LED dengan menggunakan playar dan alat pemotongan tangan. Matlamat utama menghasilkan laporan ini adalah untuk memperbaikan persediaan LED dengan mereka satu konsep baru untuk membengkok dan memotong LED dalam kuantiti tertentu serentak dijanakan oleh sistem pneumatik dan dikawal oleh PLC. Projek dimulakan dengan mengeluarkan 3 konsep fixture dalam bentuk lakaran dan akan dinilai dengan menggunakan cara concept screening matrix. Konsep yang mendapat markah yang tertinggi dalam penilaian akan dipilih untuk menjalani reka bentuk prototaip sebenar menggunakan perisian solidworks dan juga memprogram mengunakan PLC. Simulasi boleh dilakukan mengunakan solidworks untuk menentukan perlanggaran dan kesilapan pada fixture. Fabrikasi akan memulakan mengasaskan dengan lukisan teknikal yang dihasilkan menggunakan solidworks selepas simulasi prototaip siap. Fixture kemudian dipasang dan diwayar bersama-sama dengan pneumatik dan sistem PLC. pengujian dan analisis dijalankan prototaip untuk menilai keupayaan-keupayaan Fixture. Kekuatan projek ini adalah dalam menyediakan konsep baru untuk memperbaiki pembuatan LED dan keupayaan alat-alat dalam automasi perindustrian.

DEDICATION

This report is dedicated to my Mother, Father and Brothers.

ACKNOWLEDGEMENT

I would like to express the deepest appreciation to my supervisor, Mr. Taufik for providing me an opportunity to work under his guidance. Without his guidance and persistent help, this report would not been possible done.

Thanks also go to the UTeM library for providing clean, quite, and well-equipped repository and database of highest order.

I would like to express my highest gratitude to my family, relatives and friends for always inspiring, supporting and believing in all my ventures.

Finally I would like to acknowledge the service of all those who have helped me directly or indirectly from UTeM to complete my research.

TABLE OF CONTENT

LIST OF TABLE

LIST OF FIGURE

LIST OF ABBREVIATIONS

LED	-	Light Emitting Diodes
PLC	-	Programmable logic controller
PCB	-	Print circuit board
DC	-	Direct current
AC	-	Alternative current
IO	-	Inputs/outputs
EN	-	Electroless Nickel
S-LEDFIX	-	Single LED machine fixture
DFMA	-	Design for Manufacture and Assembly
DFM	-	Design for Manufacture
DFA	-	Design for Assembly

CHAPTER 1
INTRODUCTION

1.1. Introduction

Light Emitting Diodes, commonly called LEDs, are needs in the electronics world. They do dozens of different jobs and are found in all kinds of devices. Among other things, they form the numbers on digital clocks, transmit information from remote controls, light up watches and tell you when your appliances are turned on. Collected together, they can form images on a jumbo television screen or illuminate a traffic light.

Basically, LEDs are just tiny light bulbs that fit easily into an electrical circuit. But unlike ordinary incandescent bulbs, they don't have a filament that will burn out, and they don't get especially hot.

Developments over the last couple of years have opened up opportunities to use LEDs in a whole new range of lighting and others applications. The manufacture of LEDs play a major role for supporting vast amount of LEDs usage in various application thus most LEDs manufacture are improving everyday in terms of manufacturing efficiency and productivity.

There are a lot of techniques and methods are implements into LEDs manufacturing and assembly system for improving or increasing the efficiency to manufacture and assembly LEDs into PCB.

1.2. Background of Problem

The biggest challenge of the industrial manufacturing in the 21st century is to reduce assembly time of a production to decrease production cost and increase manufacturing efficiency.

The preparation of component such as LEDs before an assembly conducted is important. The method used in preparing the component will affect the quality of an assembly and might be a vital point to be taken serious.

The preparation for production means bending the lead to the correct pitch (hole distance) and cutting the leads to the appropriate length. Most components are delivered on paper tape that can be handled by a cutting and bending machine.

All LEDs components are manually placed in the PCB. The leads are fit into the holes and extend about one millimeter.

Manual bending and cutting requires human labor that cost a lot of time and not reliable in terms on the bending and cutting quality of the lead using pliers and hand cutters.

The current LED fixture which is developed by previous student is support only single LED and much slower by insert one by one feeding mechanism.

1.3. Statement of Problem

The purpose of the project is to carry out the answer for the following questions or problem statement:

- How does the fixture design of multi LED machine can increase the productivity of an assembly line?

- What is the ideal shape of LED's lead after performing bending and cutting for matching the assembly product specification?
- What is the ideal concept design of multi LED fixture for bending and cutting process?
- How the design of the LED fixture affects the quality of production assembly?

1.4. Objective

- To study the concept of design and parameters of the fixtures mechanism.
- To improve the existing design of the single LED fixture which is developed by previous student.
- To apply the PLC and pneumatic mechanism into the concept of design.
- To design a multi LEDs fixture for lead bending and cutting.
- To develop prototype of the multi LEDs fixture.
- To run testing on the prototype.

1.5. Scopes

The project will focus on the design and fabrication of the multi LEDs fixture, which apply on the design and development of the fixture using appropriate pneumatic cylinder system controlled by using PLC system. The pneumatic and PLC systems would be able to works together for bend and cut the LED simultaneously to the required shape and length. In addition, this fixture machine would be able to perform for multi LED. The LEDs fixture will be able to cut and bend at least 4 units of LED in a row. The mechanism of the fixture is to hold multi LEDs into position and to be cut and bend to desire shape. Pneumatics actuator will be use to move the lead cutter and bending device to perform their process respectively. There will be a manual hand turning to pull the paper taped LEDs into the fixture. By choosing multiple designs sketches and decide the best design to be fabricate into first prototype. There will be some design software use

on designing and producing mechanical drawing for fabrication of the fixture. In this project, SolidWorks design software will be use to produce mechanical drawing for fabrication purpose and also for analysis simulation. Testing and analysis are made on the prototype for further improvement of the fixture.

1.6. Project Outline

Chapter 1 introduced the basic purposes of the project, problem statement, objective and scope of the project. In this stage, basic information of the project is obtain and start to review the scope and objective of the project and gather some technical information on designing fixture concept.

Chapter 2 is the period that producing literature reviews which is the time that a numbers of journals, books and reports related to the project being gathered and reviewed. In this section, journal that regarding on pneumatic, PLC, automation system, and fixture are being study and reviewed.

Chapter 3 defined the methodology in designing of multi LED fixture machine. This section will explain the type of software or tools used in the process of fixture designing. Brief explanation for the procedure of the progress of fabrication of fixture is also included in this chapter.

Chapter 4 is the result and discusion section. This chapter will explain the resulted lead shape of the LEDs form by the fixture. The information such as modeling, wiring, programming and fabrication will be explained in detail. The testing and analyze data from the LEDs and fixture will included in the chapter for further discussion. The result of the project will show the overall progress of the project. The discussion section will compile and discuss the result obtained. The fixture capabilities and efficiency of the bending and cutting process will also be discussed.

Chapter 5 of suggestion and conclusion will conclude the overall result and progress of the project. The summary of testing and analysis of each module will be compute. Suggestion on improving the whole project in various aspects will include to the chapter.

The appendix will include the relevant diagram such as the Gantt Chart of PSM, technical drawing and electrical diagram.

CHAPTER 2
LITERATURE REVIEW

2.1. Light-Emitting Diode (LED)

A light-emitting diode (LED) is a semiconductor diode that emits light when a electrical current is applied in the forward direction of the device, as in the simple LED circuit. The effect is a form of electroluminescence where incoherent and narrow-spectrum light is emitted from the p-n junction. When electrical current passes through the diode the semiconductor emits infrared radiation, which the phosphors in the diode absorb and reemit as visible light. The visible emission is useful for indicator lamps and alphanumeric displays in various electronic devices and appliances. Devices such as remote controls and cameras that focus automatically use infrared LEDs, which emit infrared radiation instead of visible light.

Light-emitting diodes use the properties of electroluminescence, in which certain substances emit electromagnetic radiation when excited by the flow of an electric current, and fluorescence, in which some substances absorb wavelengths of electromagnetic radiation other than visible light and reemit the radiation as visible light. When charged particles such as electrons pass through certain semiconductors, they boost to higher orbits one or more electrons in some of the atoms in the semiconductor. When these electrons fall back to lower orbits, the atom emits infrared radiation. When this radiation strikes a phosphor atom, electrons in the phosphor atom jump to higher orbits. The phosphor atom emits visible light when the electrons fall back to a lower orbit.

LEDs are made of a combination of elements from column III of the periodic table, such as aluminum, gallium, and indium, and column V of the periodic table, such as phosphorus, arsenic, and antimony. LEDs are made of semiconductors called III-V compound semiconductors. By changing the elements that compose the semiconductor and the ratio of column III elements to column V elements, LED manufacturers change the characteristics of the LED, including color, amount of visible versus infrared radiation, and brightness.

2.2. Fixture

Fixture is production workholding device used to manufacture, duplicate or process part accurately. The fixture must be design to serve certain purpose and insure the objective of the desired process to be done correctly and without damaging the workpieces. Fixture is design to hold, support and locate a work piece. Fixture may vary in design from relatively simple tool to expensive, complicated device. Fixture also help to simplify some operation to be perform on special equipment.

Fixture differs from other tools in that they are designed o hold specific part during specific operation. A welding fixture for a particular car hood will be different from the on used to check that same hood assembly.

For assembly fixture, each part of the assembly to be placed in the fixture is drawn in a different color. Generally, the parts are drawn from largest or most important to smallest or least important in the following color order: red, blue, green, brown, orange. If there are more parts than these colors will accommodate, you can proceed with purple and yellow, then on to varying shades of these colors, (Campbell 1994).

2.2.1. Fixture Prints

Original drawings prints stay in the design room. Only prints are sent to other sources for approval, or t the tool shop to have the fixture built. If a print gets dirty,

lost, or destroyed, a new one can be made from the original. Replacing an original drawing could cost large amount of money.

2.2.2. The Frame

Fixtures, regardless of type, will have some type of frame or base which holds all of the remaining components. The base might e something as basic as a piece of tooling plate, with the other components just bolted to it. This is common for simple fixture holding comparatively flat, single parts.

More complex parts and assemblies might require a large tubular steel frame designed to hold the other components in otherwise awkward positions. When designing a fixture frame, consideration must be taken to make it strong enough to remain stable. Consistency is important when come to fixture design. Struts, ribs and gussets are common parts of a fixture frame to reinforce it. Figure 2.1 is an illustration of a typical sheet metal cross section and a fixture frame. Firstly, the part is traced onto the drawing and then the fixture is started. As the design progressed, the fixture designer will develop the components which will fill up the gap, (Campbell 1994).

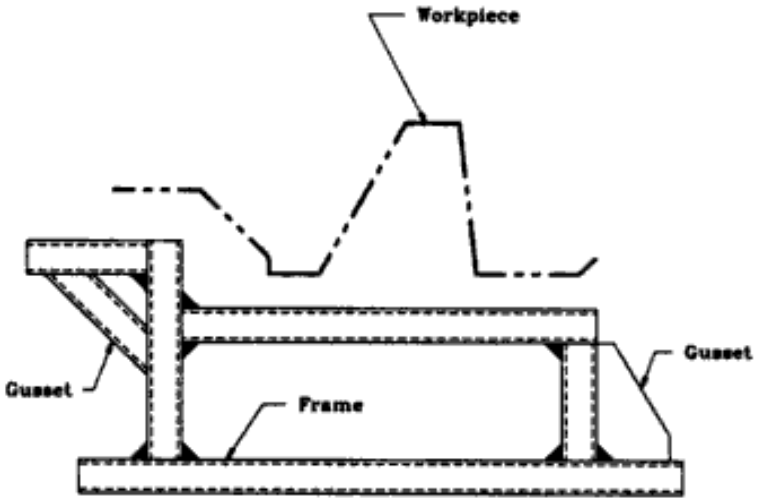

Figure 2.1: Typical beginning of a fixture design layout.