UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIGHT WEIGHT MANUAL LIFTING ROBOT

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTEM) for the Bachelor Degree of Manufacturing Engineering (Robotics and Automation) with Honours.

By

MOHAMAD ADAM BIN MOHAMAD RAJUNI

FACULTY OF MANUFACTURING ENGINEERING

2008

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Light Weight Manual Lifting Robot**

SESI PENGAJIAN: 2008/09 Semester 2

Saya **MOHAMAD ADAM BIN MOHAMAD RAJUNI**

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:

6, Hala Persahabatan Timur 1,

Taman Mewah,

31150, Ulukinta, Ipoh, Perak

Cop Rasmi:

MOHD HISHAM BIN NORDIN
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka

Tarikh: 25 Mei 2009

Tarikh: 25 Mei 2009

** 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 "Light Weight Manual Lifting Robot" is the result of my own research except as cited in reference.

Signature	:	....
Author's Name	:	Mohamad Adam B. Mohamad Rajuni
Date	:	15 April 2009

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 (Robotic and Automation) with Honours. The members of the supervisory committee are as follow:

(Signature of Principal Supervisor)

………………………………

(Official Stamp of Principal Supervisor)

(Signature of Co-Supervisor)

………………………………

(Official Stamp of Principal Co-Supervisor)

ABSTRACT

Projek Sarjana Muda (PSM) or Final Year Project is an academic research regarding research field that is compulsory for each of final year student of Universiti Teknikal Malaysia Melaka (UTeM), before being awarded a degree. The purpose of PSM is to enhance student's knowledge and capability to complete the task given within academic research in order to produce a productive and competent engineer. In this paper, a Light Weight Manual Lifting Robot has been designed and fabricated. Lifter robot is used in wide variety of material for purpose of transfer and lifting applications. It lifts a product from one spot in the manufacturing process, traveling through the following line and drops it into another location, automatically. This robot is being manufactured in order to eliminate the use of human strength in order to lift things for the manual transfer application. Conceptually, for this project, the robot used manual system that includes a handling device which is hand hold controller, actuated by an operator. The hand hold controller will function as a link between the robot operator and the robot controller circuit which determined the robot movements. The robot is designed so that it is light weight and developed with steady base support and well function of lifting mechanism in order to enhance the performance of the robot. The construction of this robot can be divided into two different areas which are electrical and electronic component, and mechanical part. The electrical constructions consist of motor driver unit, PIC controller unit, hand hold controller, and the wiring to the robot, while the mechanical constructions consist of robot base and lifting mechanism. At the end, the robot which consists of an electrical circuit to control the robot operations using hand hold controller, can be fully integrated with light weight and stable mechanical structure. The robot also includes a smooth operation of lifting mechanism.

ABSTRAK

Projek Sarjana Muda (PSM) atau Projek Tahun Akhir adalah satu penyelidikan ilmiah tentang bidang penyelidikan yang mana wajib bagi setiap pelajar tahun akhir Universiti Teknikal Malaysia Melaka (UTeM), sebelum dianugerahkan segulung ijazah. Tujuan PSM adalah untuk meningkatkan pengetahuan dan keupayaan pelajar dalam melaksanakan tugas yang diberikan dalam masa penyelidikan ilmiah untuk menghasilkan seorang jurutera yang produktif dan cekap. Dalam kertas ini, sebuah “Light Weight Manual Lifting Robot” akan direkabentuk dan dibina. Robot pengangkat digunakan dalam pelbagai perkakas bagi tujuan aplikasi memindah dan mengangkat. Ia mengangkat sebuah produk dari satu tempat dalam proses pembuatan, bergerak mengikut garis dan meletakkannya ditempat lain secara automatic. Robot ini direka bertujuan menyingkirkan penggunaan kekuatan manusia untuk mengangkat barang bagi tujuan aplikasi pemindahan. Secara konsep, bagi projek ini, robot menggunakan manual sistem yang mana mengandungi sebuah alat pengemudi iaitu pengemudi tangan, dikendalikan oleh pekerja. Pengemudi tangan akan berfungsi sebagai satu medium antara pekerja dan pengawal litar robot yang mana menentukan pergerakan robot. Robot ini dibina supaya ia ringan dan direka dengan tapak yang kukuh dan mekanisma mengangkat yang baik untuk meningkatkan keupayaan robot. pembinaan robot boleh dibahagi kepada dua iaitu electric dan elektronik komponen, dan bahagian mekanikal. Pemasangan elektrik terdiri daripada alat pemandu, PIC alat pengendali, pengemudi tangan dan penyambungan wayar ke robot, manakala pembinaan stuktur mekanikal terdiri daripada tapak robot dan mekanisma mengangkat. Akhirya, robot yang mana terdiri daripada litar elektrik untuk mengawal operasi robot menggunakan pengendali tangan, boleh sepenuhnya bergabung dengan struktur mekanikal yang stabil dan ringan. Robot juga mengandungi sebuah operasi yang lancar dengan mekanisma mengangkat.

DEDICATION

To my beloved parent, Mr. Mohamad Rajuni and Mrs. Norsiah;
supervisor, Mr Mohd Hisham B. Nordin;
special friend, Faridah Omardin;
and to my housemate, Apis, Ajis, Addam, Akam and Abie;
whose love of reading has been an inspiration.

ACKNOWLEDGEMENT

I would like to express my gratitude to all those who gave me the possibility to complete this project. Especially, I am obliged to my beloved parents, who are always be there for giving me support, strength, and great help in difficult times. Both of them are my source of inspiration that lead me to working hard in gaining knowledge. I also would like to share this moment of happiness with all my friends that helped me in completing this project in one way or another. This research has been done at fundamental Mechanics Laboratory at Universiti Teknikal Malaysia Melaka.

I am deeply indebted to my supervisor, Mr Mohd Hisham B. Nordin from Manufacturing Engineering Faculty, UTeM for all his guidance and help throughout the entire time of this project being carried out. Without her wise counsel, advice and stimulating support, this project might not go well as it is. I have furthermore to thank Mr. Muhamad Arfauz B. A.Rahman and Mr. Asari, also from Manufacturing Engineering Faculty, UTeM for all their help, support, interest, and valuable hints.

Last but not least, I wish to acknowledge to all persons who involve in supporting, advising, and assisting neither directly nor indirectly for my final year project. Thank you so much.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBEVIATIONS

ABS	-	Acrylonitrile Butadiene Styrene
AC	-	Alternative current
ADC	-	Analog-to-Digital Converter
BJT	-	Bipolar Junction Transistor
CCW	-	Counter Clockwise
CPU	-	Central Processing Unit
CW	-	Clockwise
DAC	-	Digital-to-Analog Converter
DC	-	Direct current
EMI	-	Electromagnetic Interference
I/O	-	Input/Output
IC	-	Integrated Circuit
ISO	-	International Organization for Standardization
JFET	-	Junction gate Field-Effect Transistor
JIRA	-	Japanese Industrial Robot Association
LED	-	Light Emitting Diode
LION	-	Lithium Ion
MSD	-	Musculoskeletal disorder
NiCD	-	Nickel Cadmium
NiMH	-	Nickel Metal Hydride
PCB	-	Printed Circuit Board
PIC	-	Programmable Integrated Circuit
PLC	-	Programmable Logic Controller
PM	-	Permanent Magnet
PVC	-	Polyvinyl chloride
PWM	-	Pulse Width Modulation
RAM	-	Random-access memory
SR	-	Switched Reluctance

CHAPTER 1

INTRODUCTION

Robots are a source of fascination for humans because of the ease with which they carry out work that is too difficult, monotonous or hazardous for human. From the first American industrial robot application in the automotive industry in the early 1960s, robots have improved tremendously and found of other application. They are used in all types of manufacturing, assembly, medicine, and so on. Robots provide thousands of hours of service without tiring, complaining, or breaking down in dangerous or boring environments that are not suitable for humans (Groover, 2008).

Today's robots are designed and have been developed to serve the humans. Jobs which require speed, accuracy, reliability or endurance can be performed far better by a robot than a human. In manufacturing, they are used for welding, riveting, pick and placing, scraping and painting. They are also deployed for demolition, fire and bomb fighting, nuclear site inspection, industrial cleaning, laboratory use, medical surgery, agriculture, forestry, office mail delivery as well as a myriad of other tasks (Appleton, 1987).

Lifting robot is used in wide variety of material for purpose of transfer applications. It lifts a product from one spot in the manufacturing process, traveling through the following line and drops it into another location, automatically. This robot is being manufactured in order to eliminate the use of human strength in order to lift things for the manual sorting application. Operators will no longer have to face an awkward working posture and repetition of works with this robot, thus it will eliminate the work injury that being related with these jobs.

Conceptually, for this project, the robot used manual system that using a handling device which is hand hold controller, actuated by an operator. The hand hold controller will function as a link between the robot operator and the robot controller circuit which determined the robot movements. The robot can lift an object, travel to any location, and drop it into another location, as wish by its operator. The robot is designed so that it is light weight and developed with steady base support and well function of lifting mechanism in order to enhance the performance of the robot. Consequently, the robot can be called as Light Weight Manual Lifting Robot.

1.1 Problem Statement

Nowadays, there are still some of the lifting processes that being conducted manually by the workers. Manual lifting process will take a long time because human usually get tired of doing the same task repetitively, and besides, the job is too boring to be bothered with. Otherwise, the object to be lifted is large sizes and heavy weights, and it will trouble the worker to lift the object manually. This will result in lower production time due to the inefficient work condition. The repetition of these works over long period of time will definitely cause the workers to experience lower back pain and in some cases of musculoskeletal disorder (MSD). Moreover, in some serious cases, this type of injury will cause operator to get paralyze. Instead of that, the company needs some kind of device to assist the worker in lifting process.

In other case, the big company provided an automated system for lifting application in their production line. However, the automated lifting system being used in big company does not compatible for the application of the smaller company. This system is necessarily required a very high cost to be implemented. Instead of that, these systems also required an amount of space if the systems need to be installed depending on the size of the system. Otherwise, the space of the system cannot be used for other purposes.

The purpose of Light Weight Manual Lifting Robot is being developed, is to eliminate the entire problem which are described earlier. The manually lifting process that functional by this robot can be done faster than the human. Additionally, the robot can travel at any direction as wish by its operator, which means the robot can move freely, even in confined space. Consequently, this will result in higher material handling efficiency. Workers no longer lift heavy objects at the end of the production line, which makes handling procedures more efficient and flexible. Otherwise, the cost for manual lifting system is far lower than the automated lifting system.

1.2 Objectives

The main objective of this project is to design and develop a Light Weight Manual Lifting Robot that can be used as travel unit and lifting application. Additional objectives of this project are:-

a) To develop a fully functional controller that can be used to control the robot movement.
b) To rid of the requirements of relying on human strength in lifting process.

1.3 Scope

In order to build an operational robot that can be used to perform the lifting process, scopes are required to assist and guide the growth of the project. The scope should be acknowledged and intended to achieve the objectives of the project successfully on time. The following are the scope of the project:-

a) The robot shall consist of an electrical circuit to control the robot operations using hand hold controller.
b) The robot must have a stable structure.
c) The robot must have a light weight.
d) The robot shall include a smooth operation of lifting mechanism.

1.4 Benefits of the Project

This light weight manual control robot for lifting application are being developed in order to assist the lifting process that usually being done by using human power. The advantages of this robot depend on following factors:-

a) Speed

The robots allow for faster cycle times.

b) Workplace

Unlimited workplace because the robot able to move around as wish by its operator.

c) Accuracy

Robotic systems are more accurate and consistent than their human counterparts.

d) Production

The consistent output of a robotic system along with quality and repeatability are unmatched.

e) Reliability

Robots can work 24 hours a day, seven days a week without stopping, complaining or tiring.

f) Flexibility

Lifting robots can be reprogrammable and tooling such as gripper, can be interchanged to provide for multipurpose applications.

CHAPTER 2

LITERATURE REVIEWS

2.1 Introduction to Robot

When people hear the word "robot", more often than not, they probably get a picture in their mind of a clever mechanical man, perhaps R2D2 or C3PO from the movie Star Wars. That is how most people think of robots, but the robots that really exist today are quite different from the robots of comic books, cartoons, and science fiction films and books. Robots come in many shape and sizes and have many different abilities. Basically, a robot is simply a computer with some sort of mechanical body designed to do a particular job. Usually, it is able to move and has one or more electronic senses. These senses are not nearly as powerful as our own senses of sight and hearing. However, scientists and engineers are working hard to improve robots. They are constantly coming up with ways to make them see, hear and respond to the environment around them (Bethune Academy, 2003).

Figure 2.1: C3PO and R2D2 (Ryu, 2008)