UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PNEUMATIC DRIVEN 180 DEGREE ROTATION PICK AND PLACE MECHANISM WITH CONVEYOR SYSTEM

This report submitted in accordance with requirement of the UniversitiTeknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Industrial Automation & Robotics) (Hons.)

by

FATIN SYAKIRA BINTI MOHD HASSAN
B071210025
900921-04-5216

FACULTY OF ENGINEERING TECHNOLOGY
2015

© Universiti Teknikal Malaysia Melaka

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System**

SESI PENGAJIAN: **2015/16 Semester 1**

Saya**FATIN SYAKIRA BINTI MOHD HASSAN**

MengakumembenarkanLaporan PSM inidisimpan di PerpustakaanUniversitiTeknikal Malaysia Melaka (UTeM) dengansyarat-syaratkegunaansepertiberikut:

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. **Silatandakan (✓)

☐	SULIT	(Mengandungimaklumat TERHAD yang telahditentukanolehorganisasi/badan di manapenyelidikandijalankan)
☐	TERHAD	(Mengandungimaklumat yang berdarjahkeselamatanataukepentingan Malaysia sebagaimana yang termaktubdalam AKTA RAHSIA RASMI 1972)
☑	TIDAK TERHAD	

Disahkanoleh:

_____ _____

AlamatTetap:
No. 30, Jalan Seri Duyong 2/9,
Taman Seri DuyongSeksyen 2,
75460 Melaka.

Cop Rasmi:

Tarikh: _____ Tarikh: _____

** JikaLaporan PSM ini SULIT atau TERHAD, silalampirkansuratdaripadapihakberkuasa/organisasiberkenaandenganmenyatakansekalisebabdantempohlaporan PSM iniperludikelaskansebagai SULIT atau TERHAD.

© Universiti Teknikal Malaysia Melaka

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FAKULTI TEKNOLOGI KEJURUTERAAN

Tel : +606 234 6623 | Faks : +606 23406526

Rujukan Kami (Our Ref) :
Rujukan Tuan (Your Ref) :

28JAN 2015

Pustakawan
PerpustakaanUTeM
UniversitiTeknikal Malaysia Melaka
Hang Tuah Jaya,
76100 Durian Tunggal,
Melaka.

Tuan/Puan,

PENGKELASAN LAPORAN PSM SEBAGAI SULIT/TERHAD LAPORAN PROJEK SARJANA MUDA TEKNOLOGI KEJURUTERAAN PEMBUATAN (COURSE NAME): AAA BIN BBB

SukacitadimaklumkanbahawaLaporan PSM yang tersebut di atasbertajuk**"Quality and Performance Investigation of TiAlN Coated Drill Tools"** mohondikelaskansebagai *SULIT / TERHAD untuktempohLIMA(5) tahundaritarikhsuratini.

2. Hal iniadalahkerana IANYA MERUPAKAN PROJEK YANG DITAJA OLEH SYARIKAT LUAR DAN HASIL KAJIANNYA ADALAH SULIT.

Sekiandimaklumkan.Terimakasih.

Yang benar,

_____
Tandatangandan Cop Penyelia

* Potong yang tidakberkenaan

NOTA: BORANG INI HANYA DIISI JIKA DIKLASIFIKASIKAN SEBAGAI SULIT DAN TERHAD. JIKA LAPORAN DIKELASKAN SEBAGAI **TIDAK TERHAD**, MAKA BORANG INI **TIDAK PERLU DISERTAKAN** DALAM LAPORAN PSM.

© Universiti Teknikal Malaysia Melaka

DECLARATION

I hereby, declared this report entitled "Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System" is the results of my own research except as cited in references.

Signature **:……**

Name **: FATIN SYAKIRA BINTI MOHD HASSAN**

Date **: ……**

© Universiti Teknikal Malaysia Melaka

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Type your department's name here) (Hons.). The member of the supervisory is as follow:

…….

(Project Supervisor)

© Universiti Teknikal Malaysia Melaka

ABSTRACT

The pick and place mechanism is one of the technologies in manufacturing industry and designed to automatically perform “Pick and Place” tasks. This system is very important in order to increase productivity besides eliminate human errors and getting precise work. The main concept of this mechanism is about the design and development of pneumatic driven 180 degree rotation picks and place mechanism with conveyor system. This project is a basic development and modification for that type of mechanism where the development project will involve Programmable Logic Control (PLC) which is a digital computer used for automation that are designed for multiple arrangement where in this project it is for the arrangement of digital and analog inputs and outputs, Graphic User Interface (GUI) development that allows users to interact with electronic devices through graphical icons and visual indicators, hardware and software integration. This mechanism is used to pick and place objects only on their specification.The rotation of this mechanism is 180 degree (clockwise) and -180 degree (counter clockwise). The mechanism will pick up the object on conveyor and place the object on the other conveyor.

© Universiti Teknikal Malaysia Melaka

ABSTRAK

Mekanismaangkatdanletakadalahsalahsatuteknologidalamindustripembuatand andirekasecaraautomatikuntukmelaksanakantugas "AngkatdanLetak".Sisteminiadalahsangatpentingbagimeningkatkanproduktiviti di sampingmenghapuskankesilapan yang dilakukanolehpekerjadanmemperolehhasilkerja yang tepat.Konseputamamekanismainiadalahmengenairekabentukdanpembangunanpneum atikdidorongolehputaran 180 darjahangkatdanletakmekanismadisertakandengansistempengangkut.Projekinimerupa kansatuperkembanganasasdanpengubahsuaianuntukjenismekanisma di manapenghasilanprojek yang melibatkan*Programmable Logic Control* (PLC)yang merupakankomputer digital yang digunakanuntukautomasi yang direkauntukaturanpelbagai di manadalamprojekiniiaadalahuntuksusunan digital dan analog masukkandankeluaran, *Graphic User Interface* (GUI)yang membolehkanpenggunauntukberinteraksidenganperantielektronikmelaluiikongrafikd anpetunjuk visual, perkakasandanintegrasiperisian. Mekanismainidigunakanuntukmengangkatdanmeletakkanobjekmengikutpadaspesifik asi yang ditetapkan.Putaranmekanismainiadalah 180 darjah (arah jam) dan -180 darjah (arahlawan jam).Mekanismaakanmengambilobjekpadapenghantardanletakkanobjekpadapenghan tar yang lain.

© Universiti Teknikal Malaysia Melaka

DEDICATIONS

To my beloved parents

© Universiti Teknikal Malaysia Melaka

ACKNOWLEDGMENTS

I would like to thankmy advisor Mr.Maslan bin Zainon for the continuous support of my Bachelor Degree study and related research, for his patience, motivation, and immense knowledge. His guidance helped me in all the time of research and writing of this report. I could not have imagined having a better advisor and mentor for my Bachelor Degree study.

My sincere thanks also goes to my fellow lab mate in for the stimulating discussion, for the sleepless nights we were working together before deadlines, and for all the fun we had in the last four years.

Last but not the least, I would like to thank my family: my parents and to my brother and sisters for supporting me spiritually throughout writing this report and my life in general

© Universiti Teknikal Malaysia Melaka

TABLE OF CONTENTS

DECLARATION iii

APPROVAL iv

ABSTRACT v

ABSTRAK vi

DEDICATIONS vii

ACKNOWLEDGMENTS viii

TABLE OF CONTENTS ix

LIST OF FIGURES xiii

LIST OF TABLE xv

CHAPTER 1 1

1.0 Introduction 1

1.1 Background 1

1.2 Motivation of Research 2

1.3 Problem Statement 2

1.4 Problem Objectives 3

1.5 Project Scope 3

1.6 Report Outline 3

CHAPTER 2 4

2.0 Introduction 4

2.1 Journals 4

© Universiti Teknikal Malaysia Melaka

2.1.1 Simulation of Pick and Place Robotics System Using SolidWorks Soft Motion by Rosidah Sam, Kamarul Arrifin and Norlida Buniyamin 5

2.1.2 Pick and Place Robot by Mohammad Hafizuddin bin ahmad Sabri 6

2.1.3 Optimal Kinematic Design of a New 3-DOF Planar Manipulator for Pick and Place Application by Bin Liao Yunkiang Lou 7

2.1.4 Multisensor Controlled Robotic Tracking and Automatic Pick and Place by Ilhan Konukseven, Bilgin Kaftanoglu and Tuna Balkan 7

2.1.5 Modelling and Control of A Joint Driven by Pneumatic Actuator by Nonutaka Tsujiuchi, Takayuki Koizumi, Hiroto kan, Hiroyuki Takeda, Tatsuwo Kudawara and Masanori Hirano 8

2.1.6 Design of a Servo Driven, Adjustable Pick and Place Mechanism by Owen Butler, Buddhi Paranamana, William Powers and Arvind Srinivasan 9

2.1.7 Development of Robot Hand with Pneumatic Actuator and Construct of Master-Slave System by Shinya Nishino, Takayuki Koizumi, hiroyuki Komatsubara, Tatuwo Kudawara and Mikio Shimizu 10

2.1.8 Automatic Planning of Pick and Place Operation in Presence of Uncertainties by I. Mason, R. Alami and P. Violero 10

2.1.9 Pick and Place Hand Mechanism without Any Actuator and Sensors by Satoru Sakai, Yasuhide Nakamura and Kenzo Nonami 11

CHAPTER 3 12

3.0 Introduction 12

3.1 Project Methodology 13

3.2 Methodology Flowchart 15

3.3 Software Flowchart 16

3.3.1 Software Overview 17

3.3.1.1 Programmable Logic Controller 17

© Universiti Teknikal Malaysia Melaka

3.3.1.2 Graphical User Interface (GUI) 19
3.4 Hardware Flowchart 21
3.4.1 Hardware Overview 22
3.4.1.1 Servo Motor 22
3.4.2 DC Geared Motor 23
3.4.2.1 Conveyor 24
3.4.2.2 Pneumatic Cylinder 24
3.4.2.3 Solenoid Valve 27
3.4.2.4 Infrared Sensor 27
3.4.2.5 End Effector 28
3.4.2.6 Limit Switch 28
CHAPTER 4 30
4.0 Introduction 30
4.1 Progress of Final Year Project (FYP) 2 30
4.2 Results 31
4.2.1 Ladder Diagram of the PLC 31
4.2.2 SolidWork 3D CAD of Mechanism 33
4.2.3 Mechanism Develop 35
4.2.4 Graphical user Interface (GUI) 37
4.3 Analysis 39
4.3.1 Forward Kinematics Analysis 40
4.3.2 Reverse Kinematics Analysis 41
CHAPTER 5 43

© Universiti Teknikal Malaysia Melaka

5.0 Introduction 43

5.1 Achievement of Research Objectives....43

5.2 Significance of Research 44

5.3 Problems Faced During Research 44

5.4 Suggestion for Future Work 44

REFERENCES....45

APPENDIX A 49

© Universiti Teknikal Malaysia Melaka

LIST OF FIGURES

Figure 2.1: Component of Robot 1 and 2 5
Figure 2.2: Assembly of Robot 1 and 2 6
Figure 2.3: Image area and work area of the robot 8
Figure 2.4: Schematic of 1-Link Arm 9
Figure 2.5: Experimental Setup 11
Figure 3.1: Object Oriented Development Life Cycle 13
Figure 3.2: Methodology Flow Chart 15
Figure 3.3: Software Flow Chart 16
Figure 3.4: What is inside PLC 17
Figure 3.5: System Operation Flow Chart 18
Figure 3.6: A Block Diagram of Human Machine Interface (HMI) 19
Figure 3.7:HMI TouchWin TG465-MT Touch Screen Panel 19
Figure 3.8: TouchWin TG465-MT linked to PLC 20
Figure 3.9: Hardware Flow Chart 21
Figure 3.10: Pulse Width Modulation (PWM) 22
Figure 3.11: TowerPro MG995 Metal Gear Servo 22
Figure 3.12: DC Geared Motor 23
Figure 3.13: Horizontal Type of Conveyor 24
Figure 3.14: Double Acting Cylinder 25
Figure 3.15: Pneumatic Flow Chart 26
Figure 3.16: Solenoid Valve (5/2 Way) 27
Figure 3.17: Adjustable IR Reflection Sensor 27
Figure 3.18: End Effector 28
Figure 3.19: Limit Switch 28
Figure 4.1: Ladder Diagram (to be continued) 31
Figure 4.2: Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System Top View 33
Figure 4.3: Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System Front View 34
Figure 4.4: Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor SystemSide View 34
Figure 4.5: Overview for the Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System 35
Figure 4.6: Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System Top View (real product) 35
Figure 4.7: Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System Front View (real product) 36
Figure 4.8: Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System Side View (real product) 36

© Universiti Teknikal Malaysia Melaka

Figure 4.9: Human Machine Interface (red indicator) 37
Figure 4.10: Human Machine Interface (green indicator) 38
FiGure 4.12: Forward Kinematics Arm Graph 43
Figure 4.13: Reverse Kinematics Arm Graph.....44

© Universiti Teknikal Malaysia Melaka

LIST OF TABLE

Table 4.1: Angle for Each Point.....42
Table 4.2: Angle Calculated.....43
Table 4.3: X and Y Point Location 44

© Universiti Teknikal Malaysia Melaka

CHAPTER 1
INTRODUCTION

1.0 Introduction

Robotics technology has been researched and applicable in the industrial where it has reached to a matured point. Robots are used to replace people especially in the production line and suitable for repetitive work. The main aim of this project is to develop an arm mechanism which could be used as a powerful pick and place which is called as gantry robot. The design of this mechanism is with base rotation and wrist motion with a functional gripper to hold object. This project includes a PLC which used to drive the motor according to the inputs and gear motor to control the rotation of the mechanism.

1.1 Background

The Robotic Industries Association defines the industrial robot as: "A reprogrammable, multi-functional machine designed to manipulate material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks." Robots are capable of performing a wide variety of tasks, such as material handling, spot welding, arc welding assembly, dispensing, material removal, coating and inspection. Because of that, they are widely used in the general industries including foundry, metal fabrication, plastics, consumer electronics, food and beverage, machine tools, solar, pharmaceuticals and chemicals, and wood. As an example is a robot picking objects off a conveyor and placing the object on the other conveyor which require high amount of repetitive motion.

© Universiti Teknikal Malaysia Melaka

Based on the research carried out by the International Federation of Robotics (IFR), there are top 8 reasons why robot is used in the industries:

(a) Increase production output rates
(b) Reduce operating costs
(c) Improve process quality
(d) Improve workplace health & safety
(e) Increase product manufacturing flexibility
(f) Reduce material waste and increase yield
(g) Save space in high value manufacturing areas
(h) Reduce capital costs (inventory, work in progress)

1.2 Motivation of Research

The motivation is to focus on the design and development of pneumatic driven 180 degree rotation pick and place mechanism with conveyor system. The development project will involve Programmable Logic Controller (PLC) which act as the brain of the mechanism and perform work automatically with minimum supervision or intervention, Graphical User interface (GUI) development that shows the motion of the system, hardware and software integration as well as system troubleshooting.

1.3 Problem Statement

The problem statements for this project include pick and place application which requires high amount of repetitive motion that cannot be done by human, insufficient efficiency due to human error and also the deficient of productivity due to limitation of work and time of manpower.

© Universiti Teknikal Malaysia Melaka

1.4 Problem Objectives

The objectives of the project include to demonstrate the concept of how pick and place mechanism function and operate and to design and develop the hardware for pick and place mechanism with conveyor system and the combination of pneumatic and motion system using the software of Programmable Logic Controller (PLC) and Graphical User Interface (GUI).

1.5 Project Scope

There are two scopes are needed to be done to fulfill the requirement of this project which are to design a program that controls the movement of pick and place and to design and fabricate the mechanical structure for the Pneumatic Driven 180 Degree Rotation Pick and Place Mechanism with Conveyor System.

1.6 Report Outline

This report is divided into five chapters. Chapter 1 is the introduction of the project which explains the background of the project, problem statement, project objectives and the scope of the project. Chapter 2 is the literature reviews of the project which highlights the references and understanding gained from various sources such include popular periodicals, books on specific subject, reviews of research and journals. These materials are used to support the development of this project.

Project methodology, project flowchart, hardware and software overview and process flow of the project are stated in Chapter 3. The progress, analysis and result of the development of the Final Year Project 2 are described in Chapter 4 which is the result and discussion. Chapter 5 is the summary of the discussion and suggestion of the project which is the conclusion.

© Universiti Teknikal Malaysia Melaka

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will discuss mainly on the reference and understanding which is gained from various source such as books, journals, internet and previous projects. These are the materials used as the main source for this entire project by identifying the relevance of the research.

The core focus in this literature is about how a pick and place mechanism operated with different kind of method applied on the mechanism and the characteristic of the pick and place mechanism.

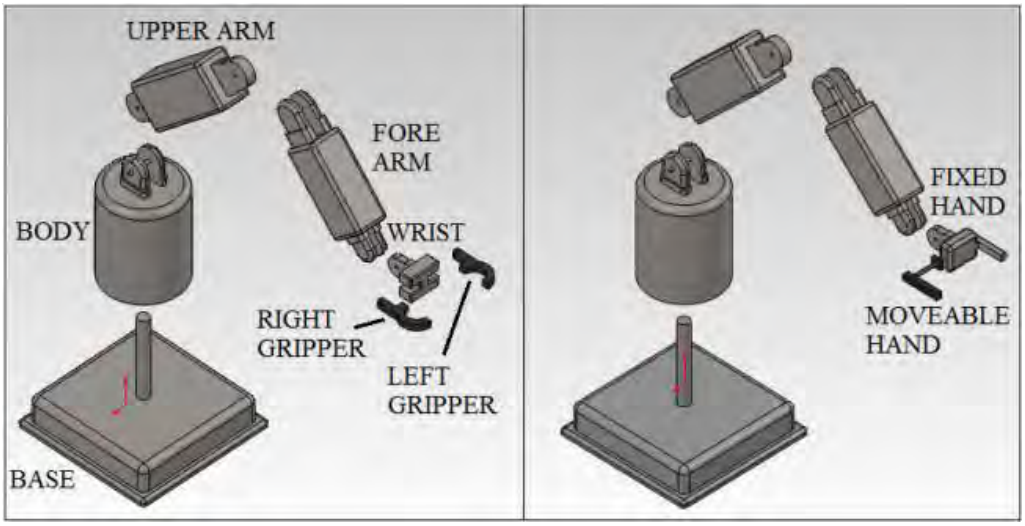
2.1 Journals

Among all the journals that have been reviewed, these are the nine journals that are most likely related to this project.

© Universiti Teknikal Malaysia Melaka

2.1.1 Simulation of Pick and Place Robotics System Using SolidWorks Soft Motion by Rosidah Sam, KamarulArrifin and NorlidaBuniyamin

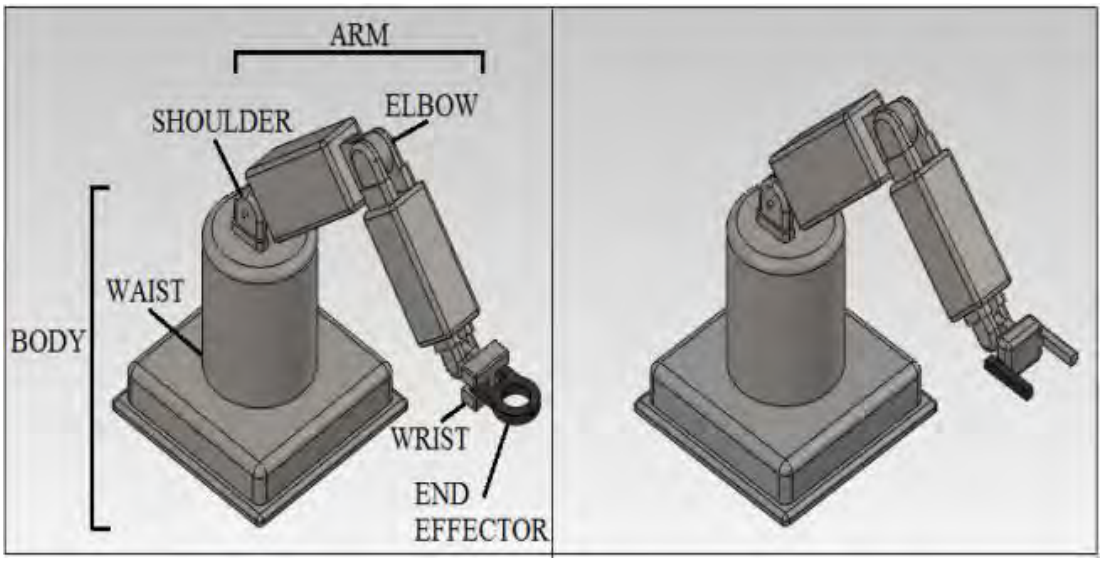
This paper is prepared based on the design of pick and place robotics system using Solidwork 3D CAD software where it is used to design a Cartesian robot and articulated industrial robotic arm with different end-effectors [1]. It is designed to shorten the robot development time and to improve the quality and speed of the designed robot. After assembled and simulation was made on the arm robot, it is presented to demonstrate the pick and place system which is proven that by using Solidworks software, it enable the user to design a robotic and assemble it to demonstrate the motion of the system made and also convenient for troubleshooting.



(a) Component of Robot 1 (b) Component of Robot 2

Figure 2.1: Component of Robot 1 and 2

© Universiti Teknikal Malaysia Melaka



(a) Assembly of Robot 1 (b) Assembly of Robot 2

Figure 2.2: Assembly of Robot 1 and 2

Figure 2.1 shows the parts on the robot 1 and 2. The different between robots 1 and 2 is the end-effectors such as robot 1 has the left gripper and robot 2 is using moveable hand. The parts of the two robots are then assembled by using mate function in the Solidwork software as shown in the Figure 2.2.

2.1.2 Pick and Place Robot by Mohammad Hafizuddin bin ahmadSabri

This project [2] is designed to facile the sorting process of heavy materials which requires high amount of repetitive motion. This robot is a basic development for that type of robot where it used Programmable Logic Control (PLC) to control the operation of the robot. It can be rotate 90 degree (clockwise) and -90 degree (counter clockwise). The arm is designed to move horizontally to pick the object without gripping it and place the object on the other side. With this robot, efficiency of the work is increased thus prevent injuries to the manpower plus inexpensive construction cost.

© Universiti Teknikal Malaysia Melaka

2.1.3 Optimal Kinematic Design of a New 3-DOF Planar Manipulator for Pick and Place Application by Bin Liao Yunkiang Lou

This paper provides an optimal kinematic design of a new 3-DOF planar parallel manipulator for pick-and-place application [3]. The researchers derived the loop-closure equations of the robot as the first step. Then, they discussed the kinematics and singularity analysis in order to use the index of the average inverse condition number. In this paper, it stated that velocities are the important element in kinematic for the pick-and-place applications. A new manipulator named V3 is co-axis actuated arrangement with three sub chains in parallel planes. As the result, an optimal design of manipulator has been design has made which can be operated under high speed.

2.1.4 Multisensor Controlled Robotic Tracking and Automatic Pick and Place by IlhanKonukseven, BilginKaftanoglu and Tuna Balkan

This paper is based on the design of robotic for recognizing and tracking an object which is selected from various unknown object and randomly placed on a moving conveyor belt using sensors in the feedback loop [4]. The robot tracks down the objects and placed them to the other place. The used of vision, infrared and encoder sensors in the feedback loop is for identifying and locates the object and dynamically servoing a manipulator for object tracking, picking and placing.

© Universiti Teknikal Malaysia Melaka

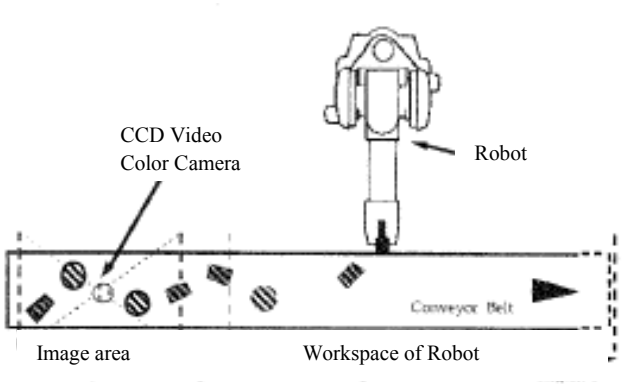


Figure 2.3: Image area and work area of the robot

Figure 2.3 shows the analysis of motion where each frame of the sequence is segmented. The objects are placed randomly on the conveyor belt and the frame-object list is used to store the parameters of the object. Sensor-based system is produced to provide information for the robotic tracking control. The motion of the end-effector is controlled by an end–effector based infrared proximity sensors and conveyor position encoder in order for the grasping system to operate.

2.1.5 Modelling and Control of A Joint Driven by Pneumatic Actuator by NonutakaTsujiuchi, Takayuki Koizumi, Hirotokan, Hiroyuki Takeda, TatsuwoKudawara and Masanori Hirano

This research is based on the focused of robot that has been used widely in the industries and perform flexible as people [5]. However, the robot needs to features safety precaution in order not to injure people. With that, the researchers had come out with the development of robot hand that can use as artificial muscle-type pneumatic actuators which functioned like human hand. In addition, big compressor is needed when a pneumatic actuator is used. To overcome this problem, they developed a low-pressure, low volume pneumatic actuator to drive and enable the robot hand perform flexibly and safely which is assume to have contact with people. PID control system is constructed in order to simulate a 1-link arm that has one degree of freedom.

© Universiti Teknikal Malaysia Melaka