DESIGN OF LINEAR CONVEYOR FOR PARTS FEEDING TO SENES ARTICULATED ROBOT

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

by

ABDUL MUIZ BIN RAMLI

B051410030

930414-08-5907

SUPERVISOR: PROF. DR. BASHIR MOHAMAD BIN BALI MOHAMAD

FACULTY OF MANUFACTURING ENGINEERING

2017

DECLARATION

I hereby, declared this report entitled "Design of Linear Conveyor for Parts Feeding to Senes Articulated Robot" is the results of my own research except as cited in references.

Signature : _____

Author's Name : _____

Date : _____

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 and Automations) (Hons.). The member of the supervisory is as follow:

……..

(Signature and Stamp)

ABSTRACT

A conveyor is a common mechanical apparatus for moving items inside a factory. The conveyors in manufacturing industries are widely used for various types of manufacturing activities such as packaging, transferring goods, pick and place, etc. the objective of this project is to design of linear conveyor for parts feeding to Senes Articulated Robot. The idea of designing the conveyor is based on parts or workpiece that will be picked and placed by a robot arm. The software for designing the conveyor is chosen based on the author knowledge. Several design ideas have been generated and divided into two components which are the frame belt and the support legs. From this designed idea, the comparison has been made to choose the best design idea. The chosen idea has been designed in SolidWorks. The important conveyor parts are designed based on specification and requirement for parts feeding to Senes Articulated Robot. The list of all parts need to be fabricated are presented in this report. The assembly design and structure tree of the conveyor to have better understanding on the conveyor assembly structure are also presented. Detail part parts and specifications are presented in solid model with the dimension which fulfils the requirement for further development. Finite Element Analysis (FEA) has been used to analyze the design. The stress, displacement, deformation and factor of safety are obtained from the analysis and presented. For future development, it was suggested to improve the parts tolerance in the design and recalculation of the power consumption.

ABSTRAK

Penghantar adalah alat mekanikal yang biasa digunakan untul menggerakkan barangan di dalam kilang. Penghatar dalam industri pembuatan digunakan secara meluas di pelbagai jenis sektor pembuatan seperti pembungkusan, pemindahan barangan, ambil dan letak, dan lain-lain. Objektif projek ini adalah untuk mereka bentuk penghantar selari abgi menghantar bahan kerja kepada robot Senes articulated. Idea mereka bentuk penghantar adalah berdasarkan sebahagian atau bahan kerja yang akan di pilih dan di letakkan oleh lengan robot. Perisian untuk mereka bentuk penghantar juga telah dipilih berdasarkan pengetahuan penulis. Reka bentuk beberapa idea telah di hasilkan dan di bahagikan kepada dua bahagian komponen iaitu bingkai dan kaki penyokong. Dari lakaran idea yang di hasilkan, perbandingan telah di buat untuk memilih idea reka bentuk yang baik. Idea yang telah di pilih telah di reka dengan menggunakan perisian SolidWorks di mana setiap bahagian penting penghantar di reka berdasarkan spesifikasi dan kehendak bagi tujuan menghantar bahan kerja kepada robot Senes articulated. Penyenaraian semua alat yang perlu di proses di bentangkan dalam laporan ini. Reka bentuk pemasangan dan struktur pokok penghantar untuk pemahaman yang lebih baik mengenai struktur pemasangan penghantar turut di bentangkan. Bahagian terperinci dan spesifikasi di bentangkan dalam model pejal dengan dimensi yang memenuhi keperluan untuk proses selanjutnya. Finite Element Analysis (FEA) telah di gunakan untuk menganalisis rekaan. Tekanan, anjakan, ubah bentuk dan factor keselamatan telah di perolehi daripada analisis dan di bentangkan. Untuk pembangunan masa hadapan, ia di cadangkan untuk penambah baikkan toleransi bahagian-bahagian yang di reka bentuk dan pengiraan semula penggunaan kuasa motor.

DEDICATION

Specially dedicate to my beloved family Mr. Ramli Bin Awang and Madam Masita Binti Amari who always have supported me. I also dedicated this report to my sibling who have inspired me. To beloved friends and all friends of 4BMFA who have been with me through my journey in education. Also thank you for all the motivation and their beliefs towards me.

ACKNOWLEDGEMENT

I would like to express my appreciation to all those who provided me the possibility to complete this report. A special gratitude gives to my final year project supervisor, Prof. Dr. Bashir Mohamad Bin Bali Mohamad, whose contribution in suggestions and encouragement, helped to coordinate my project especially in writing this report.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

FKP	-	Fakulti Kejuruteraan Pembuatan
UTeM	-	Universiti Teknikal Malaysia Melaka
CAD	-	Computer Aided Design
AC motor	-	Alternating Current
DC motor	-	Direct Current
ANSI	-	American National Standards Institute
PLC	-	Programmable Logic Controller
LAN	-	Local-Area-Network
IT	-	Information Technology
2D	-	Two dimensions
3D	-	Three dimensions
CAE	-	Computer-Aided Engineering
CAM	-	Computer Aided Manufacturing
BOM	-	Bill of Material

CHAPTER 1

INTRODUCTION

1.5 Background of Project

A conveyor is a mechanical mechanism for moving an item or material from one location to another. Conveyor is used when the material or product must be moved relatively large quantities between specific locations over a fixed path with fast and efficient for a wide variety of materials. It makes the conveyor is popular especially in material handling and packing industries. There are two type of conveyor which is powered and nonpowered. In powered conveyor, the power mechanism is contained in the fixed path, using chains, belts, rotating rolls, or other devices to move loads along the path. In nonpowered conveyor, material are move either manually by human who push the load or material along the fixed path of mechanical power provided in the fixed path or by gravity from one elevation to a lower elevation (Groover M.P.(2008)).

This project will focus on powered conveyor and basically it is automated. The conveyor must be interfaced with Senes Articulated Robot so that the part or workpiece can be reached and picked by the robot gripper.

1.6 Problem Statement

The problem with the existing Senes Articulated Robot in the FKP Laboratory of UTeM is that there is no mechanize part feeder provided to feed part to the robot. This may cause a problem and delay in feeding parts to the robot while performing a task especially for pick and place. For current usage, the manual feeding is used by students and lecturers where it is tedious, time consuming and dangerous. To solve this problem, a linear conveyor is to be designed to automate the part feeding process to the robot.

Figure 1.1: Senes Articulated Robot without a part feeder

1.7 Objectives

i. To design a linear conveyor for part feeding to Senes Articulated Robot.
ii. To develop a soft prototype of the above designed linear conveyor.

1.8 Scope of The Project

a) To design a linear conveyor for Senes Articulated Robot using suitable Computer Aided Design (CAD) software to fit the dimensions of parts for feeding to the robot. The maximum dimension of the part are as follow:

   i. Rectangular parts
      - Thickness : 20 mm
      - Width : 20 mm
      - Length : 100 mm

   ii. Round parts
      - Diameter : 20 mm
      - Length : 100 mm

   The parts could be made from steel, aluminum or plastic.

b) The conveyor will be designed based on the size of the table where the robot is mounted. The dimension of the table are as follow:

   i. Length : 1500 mm
   ii. Width : 700 mm
   iii. Height : 800 mm

c) To develop a soft prototype of the designed linear conveyor using the most suitable CAD software.

CHAPTER 2

LITERATURE REVIEW

This chapter present the literature review which is carries out for obtaining information related to the project of designing a linear conveyor for parts feeding to Senes Articulated Robot.

2.1 Conveyors

A conveyor is a mechanical mechanism for moving an item or material from one location to another. Conveyor is used when the material or product must be moved relatively large quantities between specific locations over a fixed path with fast and efficient for a wide variety of materials (Groover M.P. (2008)). In other word, a conveyor is a helpful invention for material handling by moves materials from one location to another location either with itself or with human supervise. It's make the conveyor popular especially in material handling and packing industries. The conveyor consists of two categories which is powered and nonpowered. The power mechanism for powered conveyor which is contained in the fixed path, chains, belts, rotating rolls or other device while nonpowered conveyor basically applying gravitational forces to lower elevation or use human workforce to push the load or material along the fixed path.

2.2 Types of Conveyors

Basically, the types of conveyors are made up based on its purpose and needed of industries. The variety of conveyor equipment can easily be found in the market in worldwide. It can be either powered or nonpowered conveyors. The primary interest in this design project is in powered conveyors and for the suitable types of conveyor is belt conveyor. The belt conveyor is more suitable compare to other types in order to complete a pick and place task conduct by Senes Articulated Robot. The belt conveyors itself smooth, continuous surface is good for many product handling applications. Figure 2.1 below shown several types of conveyors.

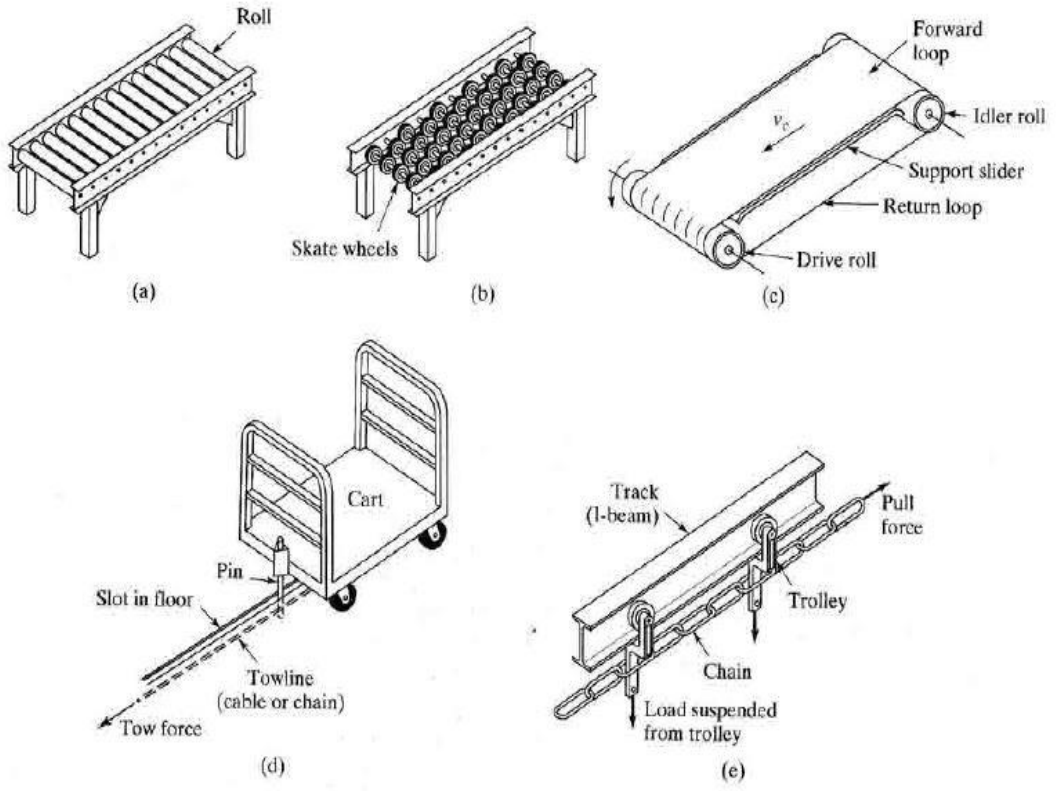

Figure 2.1 Types of Conveyors: (a) roller conveyor, (b) skate-wheel conveyor, (c) belt (flat) conveyor (support frame not shown, (d) in-floor towline conveyor, and (e) overhead trolley conveyor (Source: Groover M.P. (2008)).

2.2.1 Roller Conveyors

The pathway on roller conveyors consists a series of tubes (rollers) as shown in Figure 2.1. The tube is located perpendicular to the direction of travel. Material or product such as in pallets, tote pans, or cartons are suitable for these conveyors because possess a flat bottom surface. The mechanism used by roller conveyors is load will move when the roller is rotate. Both powered and nonpowered can be found on these roller conveyors. For powered roller conveyors, basically it is driven by belts or chain while for nonpowered roller conveyors, it is driven by gravity. Roller conveyors widely used in manufacturing, assembly, packing, sortation, and distribution. For this project design, the roller conveyors are not suitable for pick and place task for Senes Articulated Robot interface and integration because of non-flat surface.

2.2.2 Skate-Wheel Conveyors

Skate-wheel conveyors consist same mechanism as previous one which is roller conveyors but for the skate-wheel conveyors, it uses skate wheels rotating on shafts that connected to the frame to roll the material or product such as in pallets, tote pans or other containers. Compare to roller conveyors, skate-wheel conveyors have a lighter weight and sometimes are built as portable units that can be used for loading and unloading. Because of light weight, the load must generally lighter since the contacts between the loads and the conveyor are much more concentrated. The skate-wheel conveyors not consider as a good for this design project because of non-flat surface.

2.2.3 Belt Conveyors

The mechanism used by belt conveyors which is continuous loop where the length is divided into half. The half of it length is used for delivering materials and the other half for the return run as shown in Figure 2.1 (c). Usually the belt conveyors used belt that made of from reinforced elastomer (rubber) that possesses high flexibility but low in term of extensibility. Belt conveyors are powered conveyor where the drive roll that powers the belt that attach at one end of the conveyor. The rollers or support sliders in frame function as a support to the flexible belt along its forward loop. Belt conveyors consists of two common type: (1) flat belts for pallets, cartons, and individual parts; and (2) troughed belts for bulk materials (Groover M.P. (2008)). The materials that placed on the belt will travel along the moving pathway. First common type of belt conveyors which is flat belts for pallets, cartons, and individual parts can be considered as a best choice for this design project because the belt is in flat surface and suitable for any kind of material or product surface either flat surface or non-flat surface that used for pick and place task. For the second common type of belt conveyors, the troughed belt is in V-shape on forward (delivery) loop rather than flat belt.

2.2.4 In-Floor Towline Conveyor

The pathways for the conveyor system are define by the trench and towline and the towline itself driven as a powered pulley system. Located in trenches in the floor, the moving chains or cables are powered the four-wheel carts as shown in Figure 2.1(d). These conveyor systems usually used in manufacturing plants and warehouse.

2.2.5 Overhead Trolley Conveyor

A trolley in material handling is a wheeled carriage running on an overhead rail from which loads can be suspended (Groover M.P. (2008)). Overhead trolley conveyor as shown in Figure 2.1 consists of multiple trolleys that equally spaced along a fixed track. The configuration of the track system determined the conveyor path where contain a turns and possible changes.

2.3 Belt Conveyor Components

A belt conveyor consists of several important components in makeup a conveyor system which is driving or head pulley, tail pulley and belt. Besides these three components, support structure also can be considered as an important part in makeup a conveyor system. Each of these parts or components have their own advantages and to ensure that the belt conveyors work properly without any failure. The driving or head pulley is located on the discharge point where the powers of rotation of the belt and is usually fixed. The conveyor belt is driven by driving or head pulley where it is tensioning between itself and tail pulley. The driving or head pulley is rotated based on motor where act as power transmission to the system. To ensure the belt conveyor work properly, the supporting structure and belt support will withstand the load that consume by the gravity and weight of the product or material without any failure.

Although having an additional component in the belt conveyor system such as tension pulley, guiding pulley or etc. seem reliable, it is depending on the length or width of the design of belt conveyor itself. The system components required for this design project is illustrated in Figure 2.2 below.