# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

## DESIGN AND DEVLOPMENT OF TABLE NAPKIN FOLDING MACHINE

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

by

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# UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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TAJUK: **DESIGN A FOOTSTEP POWER GENERATION**

SESI PENGAJIAN: **2016/2017 Semester 1**

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I hereby, declared this report entitled “Design and Development of Table Napkin Folding Machine” is the results of my own research except as cited in references.

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# 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 in Engineering Manufacturing Technology (Product design) (Hons.). The member of the supervisory is as follow:

……..

Umi Hayati Binti Ahmad

# ABSTRAK

Kertas ini melaporkan mekanisme dan fabrikasi mesin yang boleh melipat kain napkin yang digunakan dalam industry perhotelan. Ideanya adalah untuk melipat napkin meja dengan bentuk yang dikehendaki dalam masa yang singkat. Mesin in menggunakan mekanisme seperti gear dan aci untuk berfungsi. Aci berfungsi dengan dipusingkan megikut arah jam untuk memberi elemen mesin membuat lipatan dan bergerak. Tujuan utama mesin lipat kain napkin meja ini adalah untuk melipat kain napkin meja dalam kuantiti yang banyak di dalam masa yang singkat. Selain itu, ianya juga untuk mengelakkan saiz tak terpiawai dilipat napkin meja. Borang kaji selidik telah diedarkan kepada 30 orang pengguna untuk memilih reka bentuk yang terbaik dan sesuai untuk mesin ini. Idea sistem rekaan ini diekstrak daripada mesin lipat baju yang ada di dunia pada masa kini.

Kata kunci

Prototaip lengkap; Mesin melipat napkin meja; Saiz napkin yang telah dilipat; Gear dan aci;

# ABSTRACT

This paper is explaining the design and development of table napkin folding machine mechanism and fabrication that can fold a table napkin in hospitality industry. The idea is to fold the table napkin with the desired pattern in a short time. This machine is using gears and shaft as the mechanism to function. Shaft is rotate in clockwise so the machine element can fold the table napkin. Main purpose of this table napkin folding machine is to fold a large quantity of table napkins in a short time. Besides, it also to prevent the unstandardized size of folded table napkin. A survey has been conduct to 30 random respondents to decide the best and suitable design for this machine. The idea of fabricated system is extracted from cloth folding machine that exits in world nowadays.

Keywords

Complete prototype; Table napkin, Folded size; Gears and shaft;

# DEDICATIONS

This report is dedicated to all people that hold me dear. Thank you for your continuous support during my vital educational years. Without their consent, understanding and most of all love, the completion of this final year project would not have been possible.

To my beloved parents,

My sibling,

My supportive friends,

and my supervisor,
Umi Hayati Binti Ahmad.

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# CHAPTER 1
# INTRODUCTION

## 1.0 Background of Study

There are several shape and sizes of table napkin that were used in different occasions. The shape of napkins used are usually square. Though table napkins are varying in size, they are commonly found in the following size; 16 inches, 18 inches, 20 inches and 21 inches. 22-26 inches are considering as the large napkin which is typically used for formal occasions, multiple course and meals. The larger napkin allows easier napkin folding presentations and laying across the entire lap while dining (Roberts, 1999). The material of the table napkins usually is a high-thread-count, linen or linen-cotton mix damask.

In order to reduce the time consuming and get a standard size of folded napkins, this machine only fold the easiest part of the napkins without considering the arts. The gears and shaft were used to make the machine works. As we know the function of gear is to transmit the motion of the machine besides can increase speed, increase force or change direction. Every type gear will be studied to determine which gear is suitable for this machine to functional well. Apart from that, in order to do the simulation and analysis the machine elements that were used in the machine, SolidWorks software was being used.

## 1.1 Problem Statements

Before this the table napkins were folded by the workers manually which is this conventional method is consume more time to complete the task. Each worker that need to fold the table napkins are not able to do the other task because the table napkins was hard to fold and take times. In hospitality industry, the total of table napkins used for each meal usually in a large quantity. Therefore, a machine is needed for this task to be complete in a short time. Besides, the workers have different kind of skills to fold the table napkins. This will make the folded size table napkins different between workers. Thus, a table napkin folding machine will prevent this problem to be happened in the future.

## 1.2 Objectives

The objectives for this project are:

i. To design a table napkin folding machine.
ii. To produce a functional table napkin folding machine that can reduce time consume and get a standard size of folded table napkin.

## 1.3 Scope

The scope is set as a border of this project to clarify the area of a study that would be cover in this report and which is not. The limitation of this report is included as:

i. The standard size of table napkin that will be used in this project is within the range of 9-10 inches square. This range of size were used for dessert such as beverage and cocktail. Different size of napkin is used based on the occasions.

ii. This machine will only fold one pattern of table napkin without considering the arts.

iii. This machine can only be used at hotel or in hospitality industry.

# CHAPTER 2
# LITERATURE REVIEW

## 2.0 Introduction

Folding machine is basically a machine that can fold an object such as papers, fabrics, plastics and many more using the machine element that were used in the machine. As production field is growing the development of machine continues to develop. This chapter will be continuously carried to study the past and current of research work. Some important issues and data have to be studied, reviewed, determined and applied for the project which is "Design and Development of Table Napkins Folding Machine". There are previous researches on folding machine which is using different machine elements, mechanical movements, method, and experiment design to obtain the folded table napkins. Furthermore, this chapter will be including the types of folding machine, type of machine element used and the mechanical movement in the machine.

## 2.1 Folding Machine

There are many types of folding machine in this world. For example, folding machine for fabric, paper, plastic and many more. These machine are using the same

concept for the folding motion. The mechanical movement will be studied in each folding machine.

### 2.1.1 Fabric Folding Machine

Table napkins and cloth folding machine were also included in the fabric folding machine. This is because the material for the table napkins and cloth are a little bit similar which is both are using fabric. The first folding machine that will be discussed is "Photovoltaic Powered T-shirt Folding Machine". This is an automatic motor controlled t-shirt folding machine powered by a photovoltaic system. Photovoltaic (PV) devices generate electricity directly from sunlight via an electronic process that occurs naturally in certain types of material, called semiconductors.

Electrons in these materials are freed by solar energy and can be induced to travel through an electrical circuit, powering electrical devices or sending electricity to the grid, such as Solar Energy Industries Association (2014). Gomesh, Daut, Kumaran, Irwanto, Irwan and Fitra (2013, p. 313) state that "this folding machine used four DC motors to control the motion of the folding part." The DC motor are attached to the folding motion and rotates according to a program which uses microcontroller.

There are many fabric folding machine that had already exists such as Laundroid. Laundroid is the name of the laundry folding robot that being created by Japan-based Seven Dreamers. The refrigerator-sized machine is the "first in the world to automatically fold and separate laundry". The CEO of this company, Shin Sakane said, the robot uses image-recognition algorithms to tell what kind of clothing its handling and to fold it appropriately. Segan (2016) state that Laundroid takes 3 between 10 minutes to fold one piece of laundry at a moment. They are not 100% neat, but they are folded, by machine.

**Figure 2.1: A Demonstration of Laundroid**

### 2.1.2 Plastic Folding Machine

Plastic folding machine are used to fold a box with a plastic. This process also called wrapping process. Bag folding are also one of the plastic folding process. High speed bag-folding and packaging machine particularly designed to handle sheet or flat plastic materials, although other equivalent sheet materials may be processed, such as are used for plastic bags.

This machine is to mutually fold the cut paper to the face-cloth paper, which is put into the box becoming the economic drawing style box face-cloth paper. This plastic folding machines are equipped with high quality micro process control with digital display. These machine are widely used for center and bottom sealed pouch by folding process at a high speed.

**Figure 2.2: Plastic Folding Machine**

### 2.1.3 Paper Folding Machine

Paper folding machines help speed up productivity in the office. Besides, it also can be helpful in banks, print shops, schools or any place of business that processes and mails a variety of documents and letters. Therefore, it can cut down on time spent manually for folding mailings and documents with a paper folding machine. It is a perfect-time saving tools.

These machine can fold various type of paper, low-volume or high-volume paper. The operational speed indicates how many sheets of paper can be folded within an hour's time. A paper folder that folds up to 1,800 sheets per hour is considered low-volume, while a paper-folding machine that folds up to 10,300 sheets per hour is considered high-volume (*Paper-Folding Machines,* 2016). Most paper folders have multiple folding options, usually offering around four or six selectable settings. Some common folding styles include letter, half, Z-fold, double parallel, gate and church.


**Figure 2.3: Paper Folding Machine**

## 2.2 Mechanism in the Machine

### 2.2.1 Fabric Folding Machine

A folding machine including a feeding unit feeds the sheets form a stack to a folding station. At the folding station an intermediate portion of each sheet is pushed by a pushing unit between two counter-rotating rollers to be folded in half. The feeding unit, the pushing unit and the rollers are driven by independent motors and controlled by a programmed control unit.

Usually there will be DC motor that will convert direct current electrical power into mechanical power for the folding motion. The DC motor consists of two permanent magnets and also two windings. The brushes and the commutator power the coil. Magnetic polarity of the electromagnet will change. And also the winded direction of the two magnet windings will be reversed. So it will make

one electromagnet to be north and another will be south. The basic of a DC motor can be seen in the Figure 2.4.

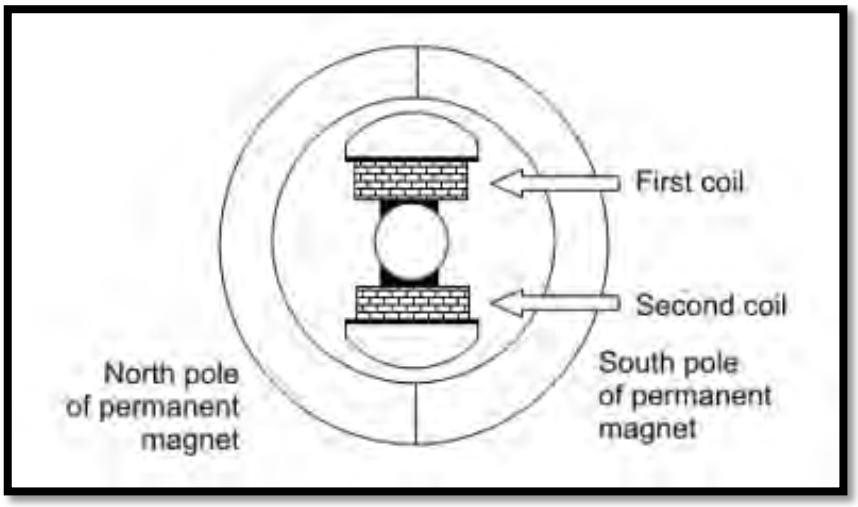


**Figure 2.4: Basic of DC Motor**

For this fabric folding machine, a 200rpm 12V DC gear motor has been used to lift up the folding material. The difference between normal DC motor and DC gear motor is, DC gear motor can hold a position without drifting, Gomesh, Daut, Kumaran, Irwanto, Irwan and Fitra (2013, p. 315). DC gear motor can rotate and return accurately to the wanted position according the program that has been added in the microcontroller.