



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DEVELOPMENT OF A NEW CONCEPTUAL MANUAL  
WHEELCHAIR USING INTEGRATED APPROACH FOR  
ELDERLY**

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

By

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## BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

**TAJUK: Development of a New Conceptual Manual Wheelchair using Integrated Approach for Elderly**

**SESI PENGAJIAN: 2016/17 Semester 1**

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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 of Manufacturing Engineering Technology (Product Design) with Honours. The member of the supervisory is as follow:

.....  
(Project Supervisor)

## **ABSTRAK**

Tujuan projek ini adalah bagi mengenalpasti masalah yang dihadapi oleh warga tua semasa proses pemindahan dari atau ke dalam kerusi roda selain untuk mengubahsuai rekabentuk kerusi roda yang sedia ada yang dapat mengurangkan keletihan dan meningkatkan fizikal atau keupayaan dikalangan warga tua. Projek ini hanya memberi tumpuan untuk mengubahsuai rekabentuk kerusi roda jenis manual. Terdapat beberapa kaedah yang digunakan untuk menangani masalah yang dihadapi oleh pengguna semasa menggunakan kerusi roda terutamanya semasa proses pemindahan. Kajian kes telah dilakukan bertempat di Rumah Seri Kenangan, Cheng, Melaka untuk mengenalpasti masalah-masalah yang berlaku semasa menggunakan kerusi roda manual dikalangan warga tua. Berdasarkan kajian kes yang dianalisa, idea untuk merekabentuk semula kerusi roda itu diterjemahkan melalui proses rekabentuk konsep. Kriteria utama adalah untuk menghasilkan rekabentuk baru kerusi roda yang boleh memudahkan proses pemindahan yang merangkumi ciri-ciri seperti ketinggian tempat duduk boleh laras dan tempat letak tangan mudah alih. Perisian AHP digunakan sebagai satu kaedah untuk memilih rekabentuk konsep yang terbaik untuk kerusi roda baru. Perisian ini akan mengira nilai penilaian berdasarkan skala berpasangan dan memilih rekabentuk konsep dengan nilai yang paling tinggi sebagai rekabentuk pilihan. Rekabentuk terperinci dihasilkan dengan menggunakan perisian SolidWork untuk membina rekabentuk yang lengkap. Projek ini membuktikan bahawa reka bentuk yang dipilih daripada kajian ini dapat memudahkan proses pemindahan dari satu tempat ke tempat lain seperti dari kerusi roda ke katil yang mempunyai aras ketinggian yang berbeza dan juga dapat meningkatkan keupayaan warga tua yang menggunakan kerusi roda tanpa bergantung kepada bantuan daripada seseorang.

## **ABSTRACT**

The purpose of this project is identify the problems that encountered by elderlies during transferring from or into a wheelchair besides, to improve the design of the existing wheelchair that will reduce physical fatigue and enhance independence or ability among elderly. This project is only focus to improve the design of manual wheelchair. There are several method that use to counter the problem that user faced while using the wheelchair especially during transferring process. Case study had performed at at Rumah Seri Kenangan, Cheng, Melaka to identify the problems that occur while using manual wheelchair among elderly. Based on the case study result that had analyse, the idea on how to redesign the wheelchair is come out through conceptual design process. The main criteria is to develop new design of wheelchair that can ease transferring process which consist of features such as adjustable seat height and fordable armrest. AHP software is used as a method to select the best conceptual design for new wheelchair. This software will calculate the evaluation value based on pairwise scale and select the conceptual design with the highest value as a selected design. Detailed design is develop by using SolidWork software to build the complete design. This project proves that the selected design from this study can facilitate the process of transferring from one place to another such as from wheelchair to bed that consist of different height as well as to increase the ability of the elderly who use it without relying on the help from someone.

## **DEDICATION**

Firstly thank to Allah S. W. T for the opportunity to finish this project. I owe this project and my true happiness to my beloved parent. Since the day I started going to this university until today, they are very caring and supporting for me.



## **ACKNOWLEDGMENTS**

This report teaches and provides me a basic knowledge of engineering and helps me to understanding more about wheelchair design. Then, I know the basic theory of wheelchair. This report inevitably involves many helping hands. First of all, I am extremely grateful and thanks to my supervisor, Mr. Mohd Nazri Bin Ahmad for all the guidance and critics given to me directly or indirectly, and also his friendly in time to teach and explain to me amicably. Once again thanks you for your idea, knowledge and guidance that make me more understand and can develop further thinking for this project.

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## **LIST OF ABBREVIATIONS, SYMBOL AND NOMENCLATURES**

HOQ	-	House of Quality
QFD	-	Quality Function Deployment
AHP	-	Analytical Hierarchy Process
BOM	-	Bill of Materials
3D	-	Three-dimensional
CAD	-	Computer Aided Design
ANC	-	Average of Normalized Column
CR	-	Consistency Ratio
RI	-	Random Index
CI	-	Consistency Index
NV	-	New Vector
PV	-	Priority Vector
P	-	Performance
S	-	Safety
C	-	Cost
M	-	Maintenance
AA	-	Adjustable Armrest
AF	-	Adjustable Footrest
ASH	-	Adjustable Seat Height
ETP	-	Easy Transferring Process
SP	-	Self-propelled
STA	-	Stability
NSE	-	No Sharp Edge
COM	-	Cost of Material
CMP	-	Cost of Manufacturing Process
ETR	-	Easy to Repair
ETD	-	Easy to Dismantle

## LIST OF EQUATION

- 4.1 - Vector of Priorities
- 4.2 - Consistency Index
- 4.3 - Consistency Ratio

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

Wheelchair is a mobility device designed for shifting patients, moving physically challenged people from one place to another with the help of attendee or by means of self-propelling. Many type of wheelchair has been creating such as sport wheelchair, work wheelchair, shower wheelchair and others. The wheelchair can be classified into two different types which is Manual powered wheelchair and the other one is Electric powered wheelchair. The redesign of manual wheelchair was considered for this project.

### 1.1 Background

Manual wheelchair type is commonly use and have developed rapidly in recent years. Manual wheelchair are driven by man power as source of energy for moving the wheelchair which is called self-propelled or it also can be propelled with the help of attendee. According to the international journal of social science and humanity on February 2015, there are about 359203 individual with disability in Malaysia are registered at the Department of Social Welfare in December 2012.

The basic designs for a wheelchair consists of two large rear wheels and two front caster wheels. Caster wheels are wheels that pivot freely about a point so that the wheelchair will able to move in any direction. There would be two movable leg rests, designed such that they can be easily turned away for the occupant to get out from the chair. There will be two handle bars above the backrest for helpers to assist in propelling the wheelchair.

The investigation of the manual wheelchair particularly transferring problems has become increasingly important because the population of individuals using wheelchair is growing and requires efficient transferring and mobility to maintain a quality of life equivalent to the general population. The disadvantages of the current designs of manual wheelchair are difficult for a user to easily transfer in or out of the wheelchair, discomfort, expensive, heavy, using spaces, unfolding and difficult of storage. Thus, this research focuses on the transferring problem and come out with specific feature to improve the existing standard manual wheelchair design for the elderly.

## **1.2 Objective**

The objectives of this project are:

- i. To identify the problems that encountered by elderlies during transferring from or into a wheelchair.
- ii. To improve the design of the existing wheelchair that will reduce physical fatigue and enhance independence or ability among elderly.

## **1.3 Scope**

The scopes of this project are listed below:

- i. Improve the design of manual wheelchair.
- ii. The usage of manual wheelchair among elderly at Rumah Seri Kenangan, Cheng, Melaka.
- iii. Transferring problem from or into a wheelchair.
- iv. Product Design Specification by using PRIEST – Decision Making Tool / AHP software.

## **1.4 Problem Statement**

Existing manual wheelchairs are complex systems and improper designs that can limit independence and accessibility. Transferring problem is the most common problem for user to getting out of a chair, getting in and out of bed, or moving from one surface to another. Besides that, transferring from two surfaces that are different height also the factor of transferring problem. The user of wheelchair among elderly always need assistant to help them during transferring process because of the limited movement. Therefore, this research focuses on the transferring problems among the elderly and come out with specific feature to improve the existing wheelchair design.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

Wheelchairs are the most efficient devices dedicated to these patients, offering them the ability to lead a normal life by allowing them to perform most of their daily activities (Sarraj A.R and Massarelli .R, 2011). A wheelchair is a device used for the mobility of people who walks with difficulty or is impossible to walk, due to aging, illness or disability. However, wheelchair is always view as a symbol of illness and loss of ability. After traumatic event such as spinal cord or brain injury, people will be resist purchasing a wheelchair on the early stage. Because they insist they will walk again. They refused to be wheelchair bounded, as it is a symbol of disability. This belief is totally not true. The wheelchair is a tool. It makes life possible for those who might need it. Even for the people with life threatening illness, the “right” wheelchair facilitate their ability to be out of sick bed, continuing their life, partaking of human experience. In other words, a wheelchair is a chair with wheels that is used to move a person who is unable to walk. The wheelchair may come in different shapes and sizes to enhance the comfort and convenience for users.

#### **2.1 History and Evolution of Wheelchair**

The first wheelchair was invented in the 1595 called as invalids chair was made for the king of Spain called Phillip. Later in the year 1655 Stephen Farfler built a self-propelling chair on a three wheel chassis. In the year 1783 John Dawson of Bath Town England invented a wheelchair named as bath wheelchair. The chair was with two large wheels and one small one. In the year 1869 patent for a wheelchair with rear push wheels and small front casters were invented, in the year 1881 the

push rims for self-propulsion wheelchair was invented (Ahmad Rifai Sarraj, 2011). In 1900 the first spoked wheelchair was invented and in the year 1916 first motorized wheelchair was invented by British Engineers. In the year 1932, Harry Jennings built the first foldable wheelchair.

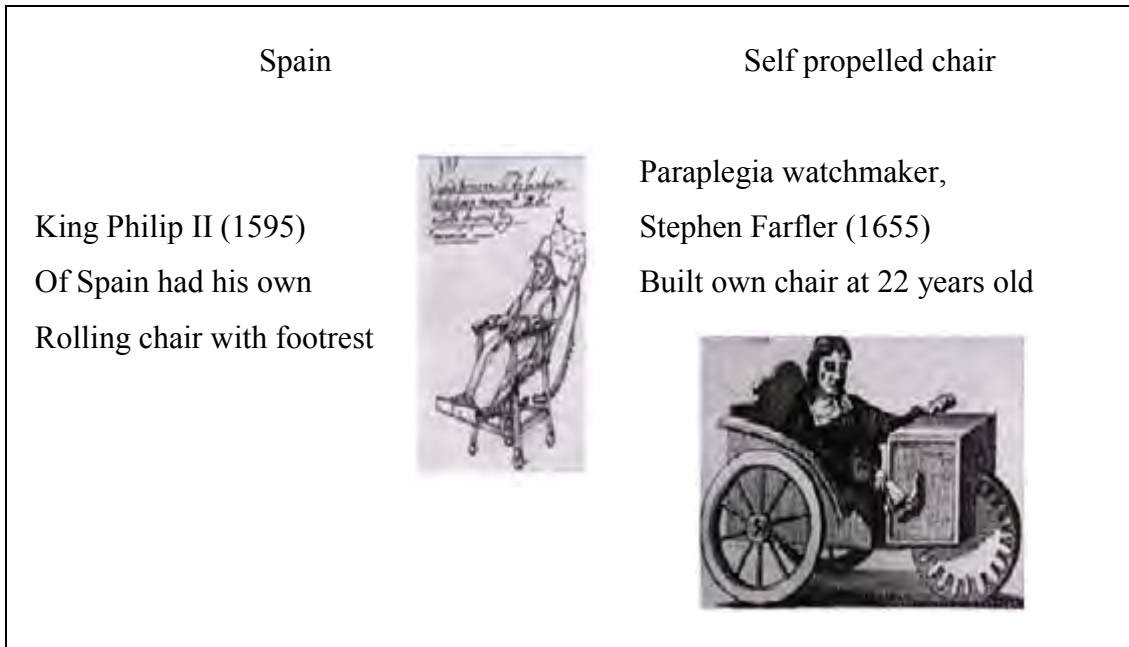


Figure 2.1: Wheelchair owned by King Philip II and self-propelled wheelchair (Ahmad Rifai Sarraj, 2011)

## 2.2 Different Types of Wheelchairs

There are various types of wheelchairs, differentiating the wheelchair is based on the mode of power used for drive. These wheelchairs are differentiated in to two types as below:

- i. Manual wheelchair
- ii. Electric powered wheelchair