



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

FLEXIBLE PARALLEL BAR FOR PHYSIOTHERAPY PURPOSES

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DECLARATION

I hereby, declared this report entitled “Flexible Parallel Bar for Physiotherapy Purpose” is the results of my own research except as cited in references. The project has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirement for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) (Hons.). The member of supervisory is as follow:

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ABSTRACT

The utilization of parallel bars in rehabilitative and active recuperations is crucially critical in the medicinal services calling. Parallel bars are utilized to enable individuals to recover their quality, adjust, scope of movement, and freedom. For individuals recouping from wounds, ailments, and other crippling conditions, parallel bars are importance things of active recuperation, recovery, and exercise hardware. However, there are some obstacles while adjusting the bar height according to patient's height. This is because the height of bar is adjusted manually by a physiotherapist .It will take time before the patient's allowed to use it. Therefore, Flexible Parallel Bar is designed to address this problem. This design consists of a control unit that will control bar on the left and right .Control panel comprises a selection switch (left and right) and up/down button .Forward reverse motor is used to downward and upward the shaft according to the desired height. In addition ,the parallel bar design is portable .This allows the family member assemble the parallel bar at home .This can save time to commute from home to a physiotherapy centre where as the physiotherapy exercises can be done at home or everywhere that request by patient.

DEDICATION

First of all thanks to Allah who has given me strength to complete this project. Then I would like to extend my gratefulness to my mother Puan Noor Riza Binti Ahamad and my father Encik Mohammad Mohsin Bin Mohd Sidek for always praying for the best for myself. It also wishes to state that I really appreciate the help, advice and guidance from my supervisor Puan Siti Nur Suhaila Binti Mirin. And finally I would like to thank my friends who always support and helping me through this project.

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LIST OF ABBREVIATIONS, SYMBOL AND NOMENCLATURE

NO	-	Normally Open
NC	-	Normally Close
DC	-	Direct Current
V	-	Voltage
SPDT	-	Single Pole Double Throw
FT	-	Feet
PT	-	Physical Therapist
MDT	-	Multi-Disciplinary Team
A	-	Amphere
N	-	Newton
cm	-	Centimetre
W	-	Watt
PB	-	Push button
RL	-	Relay

CHAPTER 1

INTRODUCTION

1.0 Introduction

In this part of chapter, the overall explained about the introduction of this project. It will explain about the background of the project, the problem statement, the objective of project, the scope or limitation of work and the deduction of the project.

1.1 Background of the project

To deal with defects and to improve the movement, function, and better life are through physical examination, diagnosis, and physical development (therapeutic use of power and mechanical movement). Such things are associated with physical therapy often abbreviated to physical therapists (PT). It was done by a physical therapist (known as a physiotherapist in most countries) and physical therapist assistants (known as physical rehabilitation therapy or physiotherapy assistants in China). In addition, for clinical practice, other activities included in the profession of physical therapy including research, education, consulting, and administration. In many settings, physical therapy services provided jointly, or other medical or rehabilitation services, including occupational therapy.

In this context, to deliver something useful, they must be based on the needs and demands of users at present. This product is named 'Flexible Parallel Bar System'. Products produced only covers one Circuits Forward / Reverse and remaining mechanical concept that is applied to make the product more flexible.

Circuit Forward / Reverse function as a motor which is designed in the form of control for controlling the movement of Automatic / Manual. In addition, the toggle switch is used in the circuit for switching between Automatic and Manual depending on the situation.

Mechanical concepts are applied in projects geared towards making the project more portable and easy to carry to the appropriate places. In addition, the hardware is in a state of prefabricated did not complicate the installation and Manual Book available. Hardware to be connected, stored in a trunk in order to facilitate the preparation.

1.2 Statement of the problem

In some places physiotherapy including government hospitals, the situation is more directed to the Parallel Bar eternal and requires a relatively large space to accommodate several Parallel Bar. In addition, the concept of not using the manual control has slowed the process and complicate the process of adjusting the Parallel Bar according to patient comfort. Therefore, methods and Portable Automatic / Manual Control is one way to reduce the problem of space required and simplifies the process of adjusting the height Parallel Bar work more efficiently.

1.3 Objective

In the construction and completion of this project there are several objectives that have example of:

- a) To design Parallel Bar heights adjustment system.
- b) To develop flexible parallel bar for physiotherapist purpose.

1.4 Scope

- a) Material that used to build the prototype based structure in this projects is stainless still and iron rod due to its durability and able to support heavy load of patient weight.
- b) The dimension of the parallel bar to hold up heavy load and provide balance in structure design which length of this project is 6ft and the width is 3ft.
- c) The screw jack type uses in this project is Core Bore M12 size that fit inside the iron rod which attached to the DC gear motor in order to adjust the height.
- d) The relay type use in this projects is SPDT (single pole double throw) which arrange two type of SPDT relay to form the H-Bridge circuit that will be utilize it function for direction of DC motor gear purpose.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this literature review section, it explains about system design, and type of elevation of the Flexible Parallel Bar for physiotherapy purpose. In the system design section will compare between Platform Mounted Parallel Bars, Bariatric Parallel Bars and Hemiplegic Parallel Bars. The type of raising mechanism that purposely for height adjustment include screw jack and hydraulic jack.

2.1 Use of Parallel Bars in Rehabilitative & Physical Therapies

The use of parallel bars in rehabilitative and physical therapies is vitally important in the healthcare profession. Parallel bars are used to help people regain their strength, balance, range of motion, and independence. For people recovering from injuries, illnesses, and other debilitating conditions, parallel bars are important items of physical therapy, rehabilitation, and exercise equipment(Mochizuki *et al.*, 2015).

Rehabilitation therapists use parallel bars for coordination exercises. These task-oriented procedures help people with balance and coordination problems, typically resulting from strokes or brain trauma. Patients are required to repeat concise movements that work more than one joint and muscle. Parallel bars are also used for ambulation exercises to improve a patient's ability to walk independently or with assistance. Before starting such exercises, however, some patient's may need to develop or improve the range of motion of their joints as well as develop any lost muscle strength(Stott and Quinn, 2017).

This kind of preparing normally starts on parallel bars and after that advances to strolling with portability helps, for example, walkers, braces, or strolling sticks. Treatment parallel bars are likewise utilized for general molding works out. This rehabilitative treatment consolidates scope of-movement, muscle-reinforcing, and wandering activities to neutralize impacts from being in a wheelchair for a maintained timeframe or from delayed bed rest and immobilization.

General molding practices are utilized to build heart and lung work too help with reestablishing important blood stream. Parallel bars are essentially imperative for walk preparing. Headed straight toward recuperation, getting ready to walk is a fantastic undertaking requiring tolerance, commitment, an uncommon measure of resolve, and the help of a physical specialist. Regardless of whether a patient can walk, they may discover it to a great degree troublesome without legitimate rehabilitative treatment. A few wounds, for example, those to the cerebrum or spine, usually impact engine abilities and may cause fits. Step preparing can enable patients to recover their typical mobile movement(Dorta, 2015)..

For any type of rehabilitation to be successful, it is critical to implement a multi-faceted, interdisciplinary course of therapy incorporating exercises and techniques that have a broad and comprehensive focus.(Vanhaudenhuyse *et al.*, 2016). The use of parallel bars for physical therapy is only a fragment of the entire process. Such therapy should always aim to restore maximum independence to all facets of an individual's lifestyle. It is important to remember that not every process of rehabilitation is the same.

There are times when different strategies are employed on the same patient and other times when the same strategies are employed on different patients. Therapists must be proficient enough to discern their patients' weaknesses and needs and thereby develop and administer exercise regimens designed to increase mobility, strength, coordination, and balance.(Dorta, 2015). Alongside the utilization of parallel bars, specialists should consolidate other restoration gear, for example, adjust sheets, practice balls, hand and finger activities, MediCordz, and protection strings, groups and tubing.

The gait training will improve the balance body of patient. Next it will make the increase of parameter and velocity waling of the patient. Therefore the patient must always do the gait training to gain their strength(Mochizuki *et al.*, 2015). Amid the recovery time frame the objective of non-intrusive treatment is muscle reinforcing, balance exercises, walk preparing, and practical preparing programs showed little to substantial impact estimate step execution enhancements in individuals with bring down appendage removal (Dorta, 2015). The patient group has some problems. Hence for patients with lower limb is divided into two. The first is a patient with a leg that needs training gait, and the second is a patient who has no leg which needs training gait.



Figure 2.1: Example of patient using parallel bar during treatment

It is imperative that the physiotherapist liaises with all individuals from the group at the distinctive stages of the restoration procedure keeping in mind the end goal to increase best result for their patient and have normal concurred objectives.(Hale, 2013). The prosthetic client needs to move by fully utilizing the Flexible Parallel Bar purpose which usually takes hours of training to be, and remain, capable.

Table 2.1: Summary of stages of physiotherapy management.(Hale, 2013)

Stage of management	Aspects
Pre-operative	Physical, functional and psychological assessment prior to surgery to inform decision of level to amputate Provision of pre-operative exercises in preparation for postoperative period Provision of information about rehabilitation process Wheelchair and mobility practice
Postoperative	Physical and functional assessment Address pain and oedema control Practise transfers and independent function Practise use of walking aids and wheelchairs Promote wound healing, pressure care and good nutritional intake Provision of exercises for strengthening, stretching and balance in order to aid independent mobility Provide education and information for patient and carers Liaise with MDT within the hospital and community Refer to appropriate agencies for discharge
Pre-prosthetic	Prosthetic preparation: compression and shaping of the residual limb using elasticated stocking, elevation, exercise and early walking aids Improve cardiovascular fitness Provide education and information for patient and carers Liaise with MDT within the hospital and community Refer to appropriate agencies for prosthetic provision
Prosthetic	Physical, psychological and functional assessment Provision of exercises for strengthening, stretching, stability and balance Gait re-education to minimise gait deviations, achieve safe mobility and promote energy efficient function Continue pain control measures Progress walking aids and skills with the prosthesis Practise activities of daily living (dressing, cooking, walking outdoors, shopping) as part of MDT Information regarding care of the residual and remaining limbs and prosthesis
Lifelong	Maintenance exercises Further intervention when the situation changes Review appointments to reassess Liaise with community agencies Facilitate reintegration to normal living Act as long-term resource for patients, families and carers

2.2 System Design of Flexible Parallel Bar

2.2.1 Platform Mounted Parallel Bars

The Platform Mounted Parallel Bars are flexible and simple to set up. Height and width estimations stamped on the edge make it less demanding at any time to make custom adjustment to this parallel bar unit. This unit gives a more reasonable and proficient other option to complex mechanized bars, enabling clinicians to invest more energy with patients. This unit is wheelchair open and intended for offices where detached bars are required. The parallel bar can hold up to 400lbs with dimension of length 2.13m, height range 66cm-99cm and width range 45.12cm-71.12cm (CLINTON, 2013).



Figure 2.2: Platform Mounted Parallel Bars(CLINTON, 2013)

2.2.2 Bariatric Parallel Bars

This type of parallel bar is use for the bariatric or obesity patient which advantage for rehabilitation that require wide space area with 121.92cm of width, payload capacity 226.59kg and length 3m, and height range 66cm-99cm(CLINTON, 2013). Thus, this type of parallel bar have higher stress load and able to hold up force that apply on the structure. The material to build this equipment by using stainless still material. Using rustproof items is suitable for daily use. This kind of material is strong and durable. This equipment Bariatric Parallel Bars by Clinton Industries can be adjusted the height and the width.



Figure 2.3: Bariatric Parallel Bars(CLINTON, 2013)

2.2.3 Hemiplegic Parallel Bars

These bars empower stroke patients and other people who have quality and portability on just on side of the body to walk alone or with help as long and to the extent required. Highlights incorporate; Uninterrupted handrails; Floor mounted; Height alters from 26" to 44"; Overall width 19"(CLINTON, 2013)



Figure 2.4: Hemiplegic Parallel Bars(CLINTON, 2013)

2.3 Raising Mechanism

2.3.1 Screw Jack

Screw jack as react like a usual screw. It can create a motion when assemble to motor. Moreover, with implement with the cage or housing it will make the movement of object or the object will be pushed and can be pulled. It can happen when the housing or cage are on static situation(Prof *et al.*, 2017). It is valid implanted in small space.



Figure 2.5: Screw Jack(Prof *et al.*, 2017)

2.3.2 Hydraulic Jack

This type of jack is used for heavy load commonly. It makes the purpose of lifting up and down by using hydraulic power. This type is measured using Pascal's Law. There are two types of hydraulic cylinders, which are single acting and double acting (K.Sainath, 2014). Thus, the use of this, it requires high cost.



Figure 2.6: Hydraulic Jack (K.Sainath, 2014)

Table 2.2: Comparison rising mechanism (Hellems *et al.*, 2008)

Raising Mechanisms	Locking Mechanisms	Supports	Power-input
Scissor jack	Pawl	Angled posts	Human (arms/legs)
Power screw	Throw lock (mechanical handle lock)	Anchored to ground	Electricity (outlet, AC/DC)
Trailer jack	Pin	Cables	Battery
Hand crank	Rigid Prop	Platform	Air compressor
Foot pump (hydraulics)	Self-locking (square) threads	Truss	Chemical (fuel cells)
Compressor (pneumatic cylinder)	Bearing w/angled surface	Lattice	
Forklift (bike chain/gears)	Magnetic self-locking motor	Sandwiched w/platform	
Pulley system	C-clamp		
Counterweights	Ball & spring (ratchet)		
Direct drive motor	Quick release seat post		
Worm gear	Set screw		
Rack & Pinion			
Rail gun			
Air suspension			
Springs			
Stream compressor			
Lever			
Office chair			

2.4 Ergonomic concept for design

To design and improve equipment, there must implement ergonomic. It more relate to human capability and the equipment. The goal when implement this ergonomic, is to make the human comfort when use the equipment. In traditional parallel bar, it can see the screw lock for height adjustment are locate on lies at an altitude of equal distance from one point to another. The height of human is difference between each other. From the analysis journal, it can implement the concept of the lifting of trailer jack. It consists of three main materials which is inner and outer shaft and miter gear that assemble together(Hellems *et al.*, 2008). This concept can see at figure below.

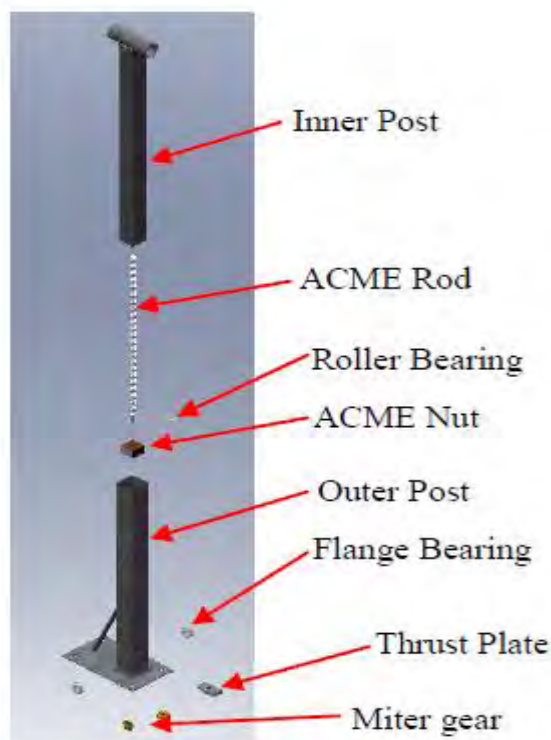


Figure 2.7: Concept of the Lifting(Hellems *et al.*, 2008)

2.5 DC Motor

It is an electrical mechanism that converting the electric power to mechanical energy, such as rotation. DC motor can separate to many type of it.

2.5.1 Motor Gear

For lifting work mostly using high torque DC motor. Which is in this type, implement the set of gear inside this motor to make it high torque and low speed. The Figure 2.7 show the example of it. The DC motor gear suitable for lifting, basic concept are for it rotate forward and reverse. It use in closed loop system. Moreover, this type of motor can lift high loads (Vaze, Mithari and Sanamdikar, 2014).



Figure 2.8: Motor Gear

2.5.2 Stepper Motor

The criteria of this type of motor is depend on angle when rotating. It type of high torque dc motor. But the high torque is depend on speed. Therefore, if increase the speed the value of torque will be decrease. Probably will not run in heavy load. It use in open loop system. Moreover, this of motor are smooth running(Vaze, Mithari and Sanamdikar, 2014).