



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DEVELOPMENT OF DIFFERENTIAL STEERING SYSTEM FOR
MICROCONTROLLER BASED MOTORIZED WALKING AID**

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

by

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ABSTRAK

Projek ini bertujuan membangunkan sistem pemanduan pembezaan untuk bantuan pejalan bermotor berasaskan mikropengawal. Laporan ini bertujuan mengatasi masalah yang berlaku pada bantuan pejalan yang terdahulu iaitu sukar dikawal supaya ia menjadi mesra pengguna untuk orang kurang upaya. Pengguna bantuan pejalan adalah samada orang kurang upaya atau warga emas, di mana kedua-duanya adalah lemah dan memerlukan sokongan untuk berjalan. Jika bantuan pejalan yang digunakan sukar untuk digunakan, menggunakannya akan mendatangkan lebih bebanan berbanding tidak menggunakannya. Maka sistem yang lebih mudah dikawal dan mesra pengguna adalah objektifnya.

ABSTRACT

The purpose of this project is to developed a differential steering sytem for microcontroller-based motorized walking aid. This study is to overcome the problem from previous motorized walker that is hard to maneuver so that it will be moreuser friendly for handicapped people. Improvement in differential steering system is needed by the walker. The user of the walker is either a handicapped person or old people, which both of these user is weak and need support to walk. If the walker is hard to use, using the walker will bring greater burden than without using it. Thus a diferrential steering system that is easy to manuever and user friendly is the objective.

DEDICATION

This project is dedicated to handicapped people who have a difficulty to walk. Also to older generations who need support to walk.

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CHAPTER 1

INTRODUCTION

Walking aid is an equipment that is used by either a person in a rehabilitation programme that is recovering from an injury or operation, or a person that is having a permanent walking difficulty due to age or accidents (Disabled Living Foundation 2006). Examples of walking aid are single-point canes, quad canes, crutches, walkers and knee walkers (Cluett 2010). The walkers, crutches and canes have various types of design for different use.

Many research has been done for walking aids. For example, there is a system on detecting a dynamic fall of a cane user by using gyroscopic chip to measure the angular velocity (Almeida *et al.* 2008). From this research, it shows that cane has low stability. Compared to walker which has four contact point to the ground, walker has higher stability. A higher stability for walking aid is important so that the user will not fall down and injured oneself. The user is a person that have difficulty in walking, thus stability is an important factor.

For walkers, there are a few types of walker. A standard or pick up walker must be lifted and moved forward step by step. Another type of walker is wheeled-walker which is more suitable for people that have tendency to fall back or have weak arms. A front-wheeled walker promotes a forward displacement of the center of gravity that allow the user to pick up speed as he goes. Related to that a four-wheeled walker is the easiest to use of the three, but it has the least stability. In addition, a four-wheeled walker is equipped with a handbrake for the user to stop (Freter 2002).



Figure 1.1: Types of walker: standard, front-wheeled and four-wheeled. (Itccatalogue)

Another type of walker is a motorized walker. A motorized walker has an advantage over normal types of walker as the user will have additional help which is energy and power from the motor to move. Motorized walker also requires less energy and fitness of cardiovascular. Furthermore, motorized walker can overcome inclined surface such as bumper or uphill road.

1.1 Problem Statement

From previous researches, motorized walker have a few problem such as having a large base area will restrict the maneuverability of the walker (Hickman *et al* 1975). Other than that, a project done in UTeM has a problem in term of its maneuvering and steering. The problem is whenever the user turns left or right, a few shifts step needs to be taken due to the center of rotation of the walker is at the wheel as shown in figure.

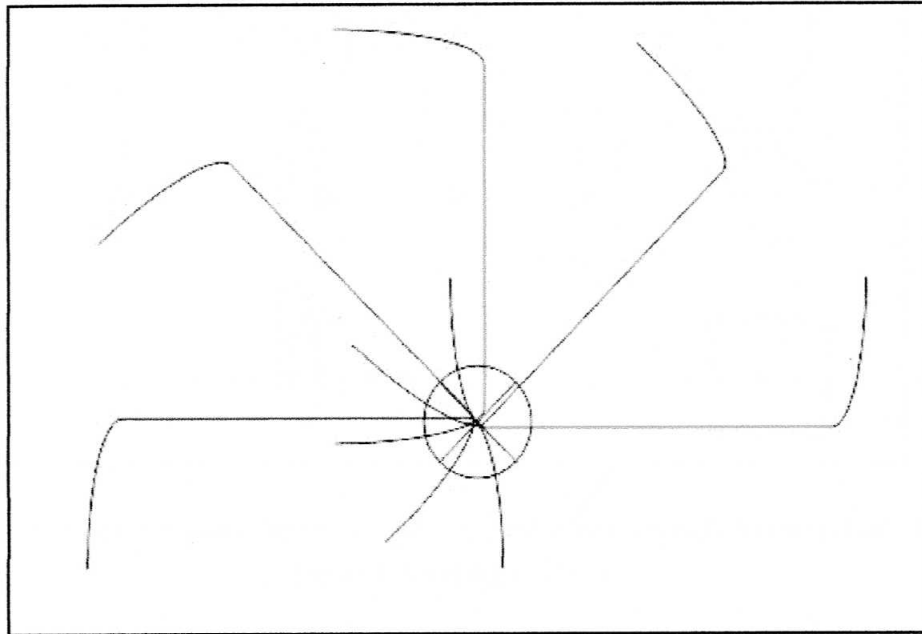


Figure 1.2: Center of rotation at the wheel

Thus the solution for this problem is to apply an easier type of maneuver system.

1.2 Objectives

- i. To develop the most suitable steering system for ease of maneuverability and steering.
- ii. To design a circuit and develop a programming to control the walker.

1.3 Scope of The Project

The scope of this project includes develop the steering system of the walker to make it user friendly. The type of locomotion used is using wheels. Other types of locomotion is not included in this project. These are several types of wheels.

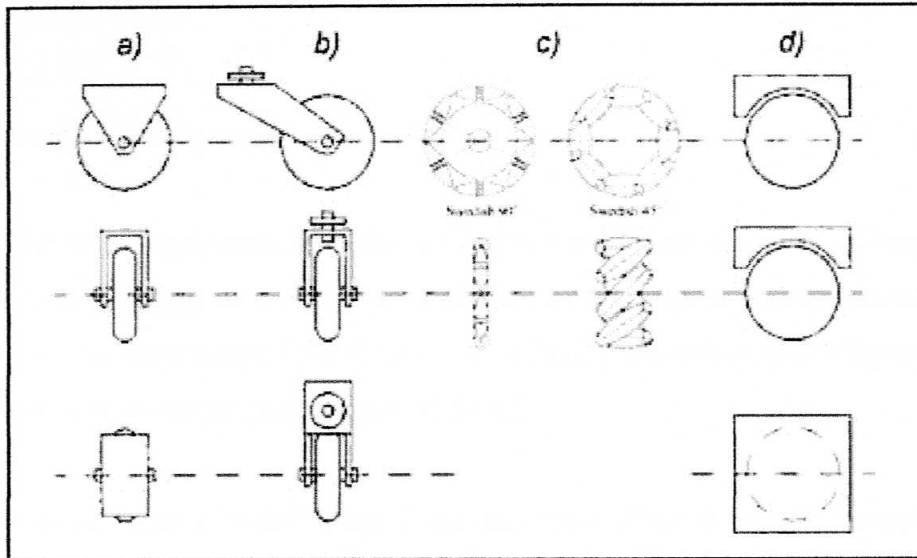


Figure 1.3: (a) standard wheel, (b) castor wheel, (c) Swedish wheel and (d) ball or spherical wheel
(Siegwart, Nourbakhsh, 2004)

The wheel needs to be suitable for both indoor and outdoor usage. The circuit and the programming for the differential drive will also be included in the scope. Other than that, the obstacle avoiding and navigation system will not be involved at all in this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Research Study on Walking Aid

Walking aid is an equipment used for several purposes such as a part of rehabilitation process where a person who is injured or undergo an operation, is recovering. Another purpose is a long-term usage for a person that is having permanent difficulty and needed walking aid such as old people or disabled people.

There are many types of walking aid. The first type is cane. A cane is a simple type of walking aid. It is easier to move around using a cane because a cane is small and does not need large space. A usual type of cane is single pointed however there are also a cane with four point of contact. A quad-cane offers higher stability than a single cane.



Figure 2.1 single-pointed cane and quad-cane (orthopedics)

Crutches also a type of walking aid. Even so, crutches are seldomly used for long term. People who have temporary disability of walking such as recovering from injuries usually use crutches. Crutches can support more weight than cane. Several types of crutches are available nowadays. Firstly there are platform crutches that offer support for those who could not support their own body. Forearm crutches can be used to support people with weak legs. Common type of crutches is underarm crutches that provide support temporarily. However, strutters are created to eliminate problems encountered in underarm crutches. Lastly is leg support crutches that help injuries on the lower portion of one leg.

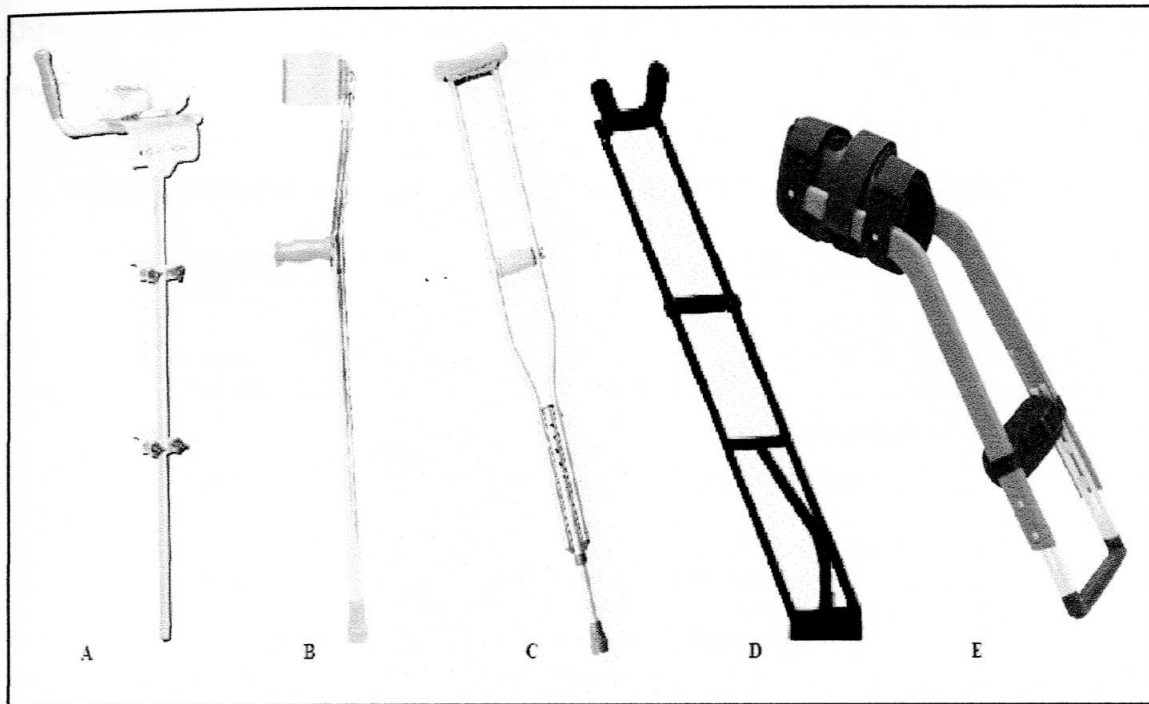


Figure 2.2 (a) platform crutch (b) Forearm crutch (c) underarm crutch (d) underarm crutch (e) leg support crutch



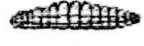
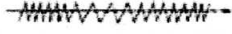

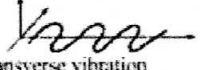






Another type of walking aid is walker. Walker gives greater stability of walking compared to cane and crutches. However, having a large frame that gives higher stability makes it harder to move around because it will require larger space to move around. Walker also have variety of types such as the standard walker, front-wheeled and four-wheeled.

2.2 Research Study on Locomotion

Locomotion mechanism is needed to enable something to move around. However, there are many ways to move such as walking, jumping, running, sliding, skating, swimming, flying and rolling. These types of motion can be seen used in biological creatures such as walking human, sliding snake, swimming fish, flying bird, and jumping frog.

Different living environment makes biological creatures have a wide variety of locomotion.

Table 2.1: Locomotion mechanism used in biological system (Siegwart, Nourbakhsh, 2004)

Type of motion	Resistance to motion	Basic kinematics of motion
Flow in a Channel 	Hydrodynamic forces	Eddies 
Crawl 	Friction forces	Longitudinal vibration 
Sliding 	Friction forces	Transverse vibration 
Running 	Loss of kinetic energy	Oscillatory movement of a multi-link pendulum 
Jumping 	Loss of kinetic energy	Oscillatory movement of a multi-link pendulum 
Walking 	Gravitational forces	Rolling of a polygon (see figure 2.2) 

2.2.1 Research Study on Wheel

In the figure above, human bipedal walking system can be approximated by a polygon that is rolling, with the span of the step equal with length d . The polygon approaches a circle with radius l as the step size decreases.

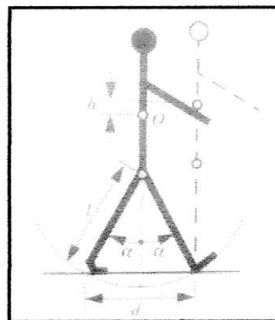


Figure 2.3: Bipedal walking system (Siegwart, Nourbakhsh, 2004)