CHAPTER 1
INTRODUCTION

1.1 Background

Walking leg mechanisms in the world of robotics have developed significantly, such as multi-DOF mechanisms with aligned joints and linkage mechanisms such as Klann and Jansen, but generally require many actuators, less smooth leg trajectories, and high torque. Previous research has shown that a better mechanism is the planar six-bar crank-driven mechanism, which requires only one actuator per leg and small torque[1].

To obtain a foot path that resembles a human step, the configuration and length of each bar are needed, so it is necessary to carry out a dimensional synthesis of the mechanism used, then the results of this dimensional synthesis need to be validated for the correctness of its characteristics through kinematic analysis[2].

Previous research on the design of a six-bar leg mechanism with a skew pantograph has been conducted and validated kinematically using GIM and MATLAB[1]. Kinematic synthesis of an adjustable six-bar mechanism with a slider output has been conducted to obtain the appropriate link length and adjustable parameters[3]. Another study analyzed the kinematic and dynamic response of a Watt-type six-bar mechanism which was validated experimentally by comparing simulation results with prototype measurement data[4]. Kinematic synthesis and analysis of an adjustable six-bar mechanism have also been conducted to demonstrate the effect of kinematic coefficients on the conversion of rotary motion into oscillation[5].

Although various studies have been conducted on the synthesis and kinematic analysis of six-bar mechanisms, including adjustable configurations, slider outputs, and experimental validation, existing works have mostly focused on achieving kinematic properties and motion transmission characteristics. Six-bar leg mechanisms with inclined pantographs have been kinematically verified, but their dimensional synthesis has not been specifically directed towards producing human-like step trajectories. Therefore, this final project aims to perform dimensional synthesis and kinematic analysis to obtain kinematic constants, namely the design parameters of a mechanism such as arm length or angle that define its geometry, that produce human-like gait trajectories.

1.2 Problem Formulations

The problem formulations in this research is how the kinematic constants of a planar six-bar crank-driven leg mechanism be determined to generate a human-like leg trajectory?

1.3 Aim

The aim of this final project is to determine the kinematic constants of a planar six-bar crank-driven leg mechanism that generates a human-like walking trajectory.

1.4 Benefit

The results of this final project are expected to contribute to the development of robot leg mechanisms by providing kinematic constants that produce human-like walking trajectory.

1.5 Problem Scopes

To maintain the focus and feasibility of this research, the following scope and limitations are established:

1. All links are assumed to be rigid.
2. The torque requirement on the crank driver is ignored.
3. Dimensional synthesis is performed on 7 main precision points.

1.6 Writing System

This final project proposal is systematically organized into several chapters to provide a clear explanation of the research process. Chapter I presents the introduction, which includes the background, problem formulation, objectives, benefits, problem limitations, and the overall structure of the research writing. Chapter II discusses the literature review, which contains theories and previous studies related to the planar six-bar crank-driven leg mechanism, dimensional synthesis, kinematic analysis, and walking mechanisms that serve as the theoretical basis for this research. Chapter III explains the research methodology, including the design approach, analytical procedures, and simulation processes used to achieve the research objectives.