CHAPTER ONE

INTRODUCTION

1.1 General Review

The inverted pendulum system is a standard problem in the area of control systems. They are often useful to demonstrate concepts in linear control such as the stabilization of unstable systems. Since the system is inherently nonlinear, it has also been useful in illustrating some of the ideas in nonlinear control. In this system, an inverted pendulum is attached to a cart equipped with a motor that drives it along a horizontal track. The user is able to dictate the position and velocity of the cart through the motor and the track restricts the cart to movement in the horizontal direction. Sensors are attached to the cart and the pivot in order to measure the cart position and pendulum angle, respectively. MATLAB/SIMULINK is used to implement the controller and analyze data.

The inverted pendulum system inherently has two equilibrium states: The stable equilibrium state in which the pendulum is pointing downwards and requires no control input to be achieved, thus, is uninteresting from a control perspective. The unstable equilibrium state in which the pendulum is pointing upwards and requires a control force to maintain this position. The basic control objective of the inverted pendulum problem is to maintain the unstable equilibrium position when the pendulum initially starts in an upright position [1].

1.2 Problem Statement

Design a control system that keeps the inverted pendulum balanced, tracks the cart to a commanded position, and then implements a feasible controller using the pole placement as the main controlling method which should be minimize both the displacement of the cart and the angle of the pendulum.

1.3 Objectives

The basic purpose of this research is to design control for an inverted pendulum using pole placement. This may be achieved through:

- Derive the mathematical model of the inverted pendulum system.
- Get the state space model and feedback gain matrix will be obtained for state feed controller.
- Design, and simulate a stabilizing controller which maintains the pendulum in the upright position for small disturbance to the pendulum.

1.4 Methodology

- Previous study to understand the concept of an inverted pendulum control system and its application.
- MATLAB language simulator will be used to simulate the model and obtain the response of the system by using pole placement method.

1.5 Thesis Outline

This research consists of five chapters as follows:

Chapter two; presents the previous work and general overview about the techniques used in design and analysis of control system. Chapter three; presents inverted pendulum control system, the mathematical model and the design of the system's controller. Chapter four**;** presents the simulation results of the system's performance before and after using the pole placement controller and compare the obtained results. Chapter five**;** states the conclusion and proposes recommendation for future work**.**