CHAPTER 1

INTRODUCTION

1.1 OVERVIEW.

Linear Quadratic Regulator (LQR) control problems have been widely investigated in the literature. The performance measure is a quadratic function composed of state vector and control input. If the linear time-invariant system is controllable, the LQR control law will be obtained via solving the algebraic Riccati equation.

The LQR tuning algorithm in microcontroller is applied to the speed control of DC motor. The performance measure to be minimized contains output error signal and differential control energy. The LQR controller receives error signal only and it doesn't need to feedback full states. The Q matrix can be determined from the roots of the characteristics equation. Once the poles for the closed-loop system are assigned, the existence criteria of the LQR controller are derived.

In the motor control systems, error detector signal are used to provide feedback information on the motor. This error comparator is used in the control loop and to improve the reliability by detecting fault conditions that may damage the motor.

1.2 OBJECTIVE RESEARCH

The main core objective of the project is to explore about the quadratic optimal control or LQR and design a system and programming to control speed of servo motor using LQR controller, so it can move based on pulse by using microcontroller. The system and the programming will be able to control the motor speed so motor will move according the speed needed.

1.3 PROJECT SCOPE

In order to achieve this project, there are several scopes had been outlined:

i. To choose the optimal value of feedback gain in order to grab the stable system.
ii. The error speed signal is used to provide feedback information to the LQR controller in microcontroller.
iii. The servo motor will be as output that generates the mechanical energy from electrical energy in microcontroller.
iv. To describe how a MC68HC11 can be used to implement a speed Linear Quadratic Regulator feedback control in the unstable system.

1.4 PROBLEM STATEMENT

The problem statement in this project is about how to determine the LQR gain matrix for the unstable system and how to apply the feedback control to the microcontroller. To find the LQR gain, need to consider Riccati equation and eigenvalues and find Q using optimal cost function. Build control block diagram to find the equation of error signal and program it to the microcontroller.

1.5 THESIS ORGANIZATION

This thesis will consist five chapters. For the chapter 1 it discuss the background of the system, the objective of these project, scope, problem statement and the summary of work. In chapter 2 it will discuss more on the literature review that have been done. It will discuss about the Linear Quadratic Regulator (LQR), Clifton Precision Servo Motor, Motor Drive G340 and Motorola MC68HC11 microcontroller. In chapter 3, the discussion will be on methodology hardware of the project and so as the software implementation of the project. The result, analysis and discussion will be on the chapter 4. Finally, chapter 5 will discuss the conclusion of the project and future work can be done to this project.