AUTOMATIC GATE CONTROL

MAT FAIZAL BIN OMAR

MAY 2007

"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrumentation and Automation)"

Signature : .....

Supervisor Name : Madam Hamimi Fadziati bt Abd Wahab.

Date : 7/5/07

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Faculty of Electrical Engineering
Kolej Universiti Teknikal Kebangsaan Malaysia

May 2007

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references."

Signature : .....

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Date : 7/05/2007

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ABSTRACT

The work presented here outlines the development of a programmable logic controller (PLC) based automatic gate. The inconveniences encountered in gate operations have called for an immense search for solutions. The programmable logic controller based automatic gate offers everything necessary to put an end to these inconveniences as it incorporates the ladder diagram. Specifically, the system described in this paper monitors the entrance gate. The automatic gate senses any vehicle approaching it. It automatically opens, waits for vehicle to move, and closes after the vehicle has left. The automatic gate described here can be applied to automate the entrances to parking lots of residential homes, organizations, automobile terminus, and public car parks. It used to avoid the stress of manually opening and closing the gate. The technology used eliminates gate monitoring and manning by human beings. The gate uses a state-of-the-art entry system. The gates have to perform gyrations – open, auto-reverse, stop, fully close and fully stop. The automatic gate developed in this project is unique in that it is controlled by software, which can be modified any time the system demands a change.

ABSTRAK

Automatic Gate Control atau kawalan pintu pagar secara automatik merupakan satu projek yang akan memenuhi keselesan dan keperluan pengguna mahupun premis-premis tertentu di zaman yang serba canggih ini. Pada masa kini, biasanya pengguna lebih cenderung menggunakan pintu pagar kawalan jauh atau *remote controlled gate* untuk mengawal pembukaan dan penutupan pintu pagar. Projek ini dibangunkan dengan menggunakan *programmable logic controller(PLC)* sebagai litar kawalan untuk mengawal pergerakan pintu pagar tanpa menggunakan tenaga manusia. Dengan berhasilnya projek ini, pengguna tidak lagi perlu untuk keluar dari kenderaan mahupun membawa alat kawalan jauh untuk melepasi pintu pagar. Ini kerana projek ini menggunakan suis ultrasonik untuk mengesan kehadiran kenderaan. Alat pengesan atau photosensor yang lain pula akan mengesan kenderaan yang melepasinya menerusi gangguan sinaran cahaya. Daripada tindakbalas terhadap gangguan ini, litar kawalan akan mengawal motor yang akan membuka atau menutup pintu pagar dengan tindakan *forward* dan *reverse*.

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CHAPTER 1

INTRODUCTION

The need for automatic gates has been on the increase in recent times. The system described here incorporates the use of PLC as a controller in achieving the aims of this project. Almost all areas of technology have started taking advantage of the inexpensive computer control that PLC can provide. The automatic gate described here automates the entrances to parking lots of residential homes, organizations, automobile terminus, and public car parks. It is automatic to avoid the stress of manually opening and closing the gate. The technology used eliminates gate monitoring and manning by human beings.

As a monitoring and control system, the programmable logic controller was used to read in data values from the input device and interact with the outside world. The system senses, opens and closes the gate automatically. The developed prototype of automatic gate system comprises a sensor unit, a control circuit, CPU module, memory module, display unit, gate control unit and the power supply unit.

1.1 Objectives

The objectives of this project are as follow:

- To develop the prototype of automatic gate control by using programmable logic controller.
- Implementation of software based on ladder diagram to automates the gate's opener and closed.
- The design and implementation of hardware for automatic gate.
- Interfacing the hardware and software to develop the prototype of an automatic gate control and testing the result.

1.2 Scope

This project is limited to several points as below:

- Develop the software by using ladder diagram to control gate automatically.
- Combine the software and hardware to develop gate prototype that automatically controlled.
- Testing the combination of hardware and software.

1.3 Problem Statement

The automatic gate is not a security device and should not be construed as one. It provides convenient access and intelligent features that makes it distinct from all other gates which bring it so close to a security device. This project was developed to solve the problem stated below:

- Present remote sensor gate usually easy to damage.
- Consumer need to waste time to lock and open the manual gate.(for those who use an ordinaty gate)
- Should brought remote control device anywhere and forced to repair if damaged (for those who use remote controlled gate)

1.4 Expected Result

The results that have been expected from this project are to accomplish the prototype of an automatic gate control by using programmable logic controller.

- Ultrasonic Switch will detect the presence vehicle while IR Sensor senses the crossing vehicle by the beam interruption.
- This interruption cause the gate to closed only when the vehicle cross the gate properly.
- The input will receive in control circuit to actuate the DC motor in forward or reverse direction.
- Then the gate will automatically open and close.

1.5 The Summary of Final Report

This final report consists of six chapters. The remaining five chapters are as follows:

Chapter two gives an overview of the case study that has been done in accomplishing this project.

Chapter three gives a summary of project background such as the function of programmable logic controller, ultrasonic sensor, and IR sensor.

Chapter four present the brief description of project methodology.

Chapter five reveals the results obtained and gives some description of the outcome of the project.

Chapter six gives the discussion, conclusion, and recommendation of the project and suggest future work that could be done to expand this project title.

CHAPTER 2

LITERATURE REVIEW

There are several theses that have been reviewed to achieve the primary goal of this project. This is important to make sure the development of the project is on the project's scope.

2.1 Designing Dependable Logic Controllers Using The Supervisory Control Theory by Jean-Marc ROUSSEL, Alessandro GIUA.

In this paper the authors deal with the problem of designing a controller for a discrete event system. They argue that the classical approach of supervisory control theory (SCT) can be used as an essential step of such a procedure. However, some of the features that make supervisory control an attractive paradigm to solve theoretical problems are often a major source of difficulty in implementing a controller: such is the case, for instance, of the abstraction level usually considered in SCT. They define a method to obtain the correct abstraction level and present a procedure to design a controller using SCT. This approach is applied to a simple but realistic example: an automatic gate.

2.1.1 Description of Case Study

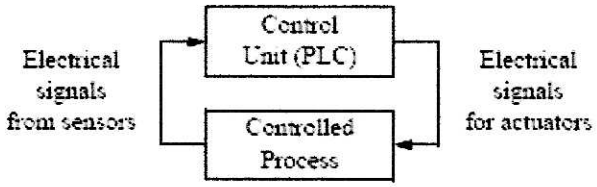

Figure 2.1: Decomposition of the system

In this case study, the plant was composed of several elements:

- a gate with 2 limit switches to indicate when the gate is fully open or fully closed,
- an electrical motor with 2 contactors to control the direction (one per direction),
- a receiver for the user's remote controls,
- a sensor to detect the presence of a vehicle in front of the gate.

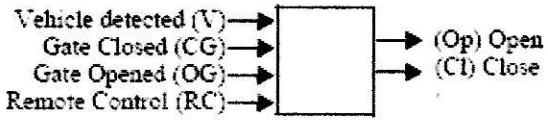

Figure 2.2: Inputs and outputs of Control Unit (PLC)

2.1.2 Control specifications

The desired behavior of the plant may be expressed by the set of specifications given hereafter in plain natural language. Among these 7 specifications, the first three are related to vivacity requirements (what must be done to perform the expected task). Specification P4 expresses a safety requirement. Specifications P5 and P6 express constraints coming from actuators and the last one is an assumption on the correct operation of the sensors (the problem of sensors monitoring is not deal with in this study).

The specifications areas follow:

P1 - When the remote control is activated, the gate opens.

P2 - When the gate is open with no request from the user or no detection of a car, the gate closes.

P3 - While the gate is not totally closed, the detection of a car causes the reopening of the gate.

P4 - The gate must never be simultaneously controlled to open and to close.

P5 - An open gate can not be controlled to open.

P6 - A closed gate can not be controlled to close.

P7 - The gate is never simultaneously open and closed.

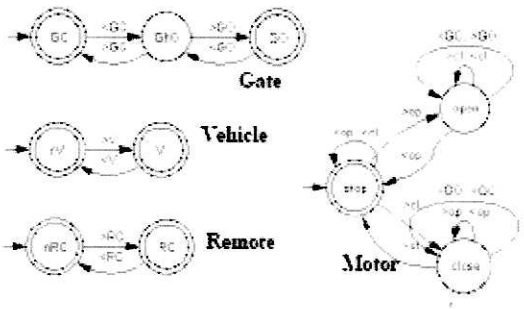

Figure 2.3: Plant Model of the automatic gate.

By review this case study, the concept and the based of the system is similar to this project, that is to implement the automatic gate system by using control systems such as PLC. For this case study, they use the remote controlled to opened and closed the gate, but in this project, the gate is automatically opened and closed.

2.2 Design of A Microprocessor Based Automatic Gate

The system described here incorporates the use of a microprocessor as a controller in achieving the aims of this project . The automatic gate described here

automates the entrances to parking lots of residential homes, organizations, automobile terminus, and public car parks. It uses a remote control convenience to avoid the stress of manually opening and closing the gate. The technology used eliminates gate monitoring and manning by human beings. The gate uses a state-of-the-art entry system. The gates have to perform gyrations – open, auto-reverse, stop, fully close and fully stop.

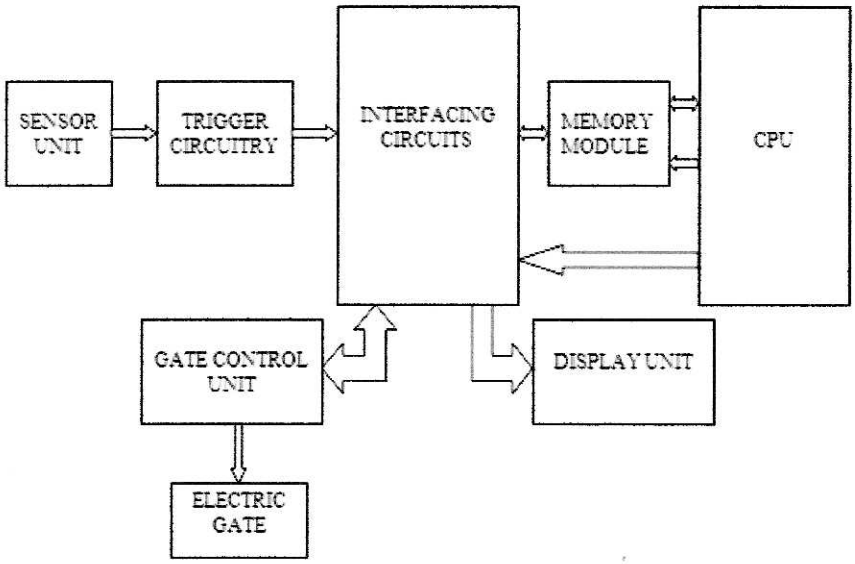

Figure 2.4: Block Diagram of the System.

2.2.1 Sensor Unit

This module makes use of an optical sensor, specifically a light dependent resistor (photo conductive cell), whose resistance changes with the intensity of light. The type used is ORP12 and it has a dark resistance of 10MΩ. The sensor unit is shown in Figure 2. When light rays are focused on the LDR, the resistance becomes very low (0-500Ω) but when the rays are interrupted, the resistance increases to its dark resistance. The variable resistor is used to vary the sensitivity of the LDR. It is otherwise called Dark Activated Sensor.

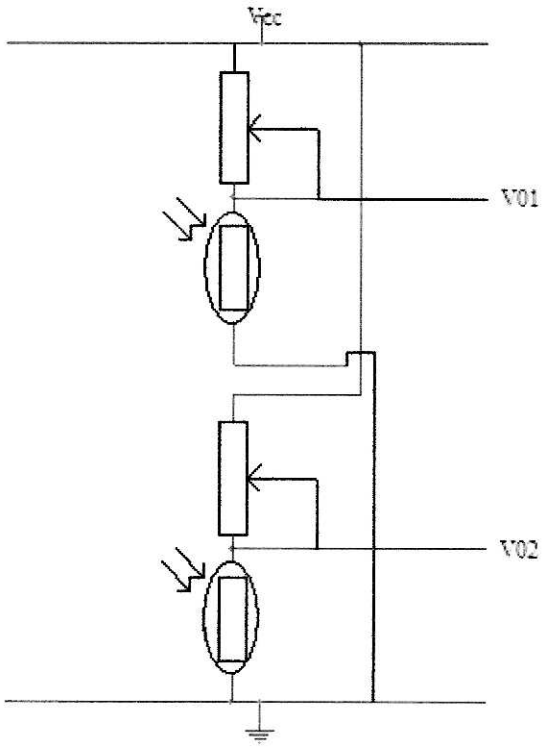

Figure 2.5: Sensor Unit.

2.2.2 Software Design

Designing software for the automatic gate was not a trivial task. In the development cycle of a microprocessor-based system, decisions are made on the parts of the system to be realized in the hardware design and the parts to be implemented in software. The software is decomposed into modules so that each module can be individually tested as a unit and debugged before the modules are integrated and tested as a software system in order to ensure that the software design meets its specification.

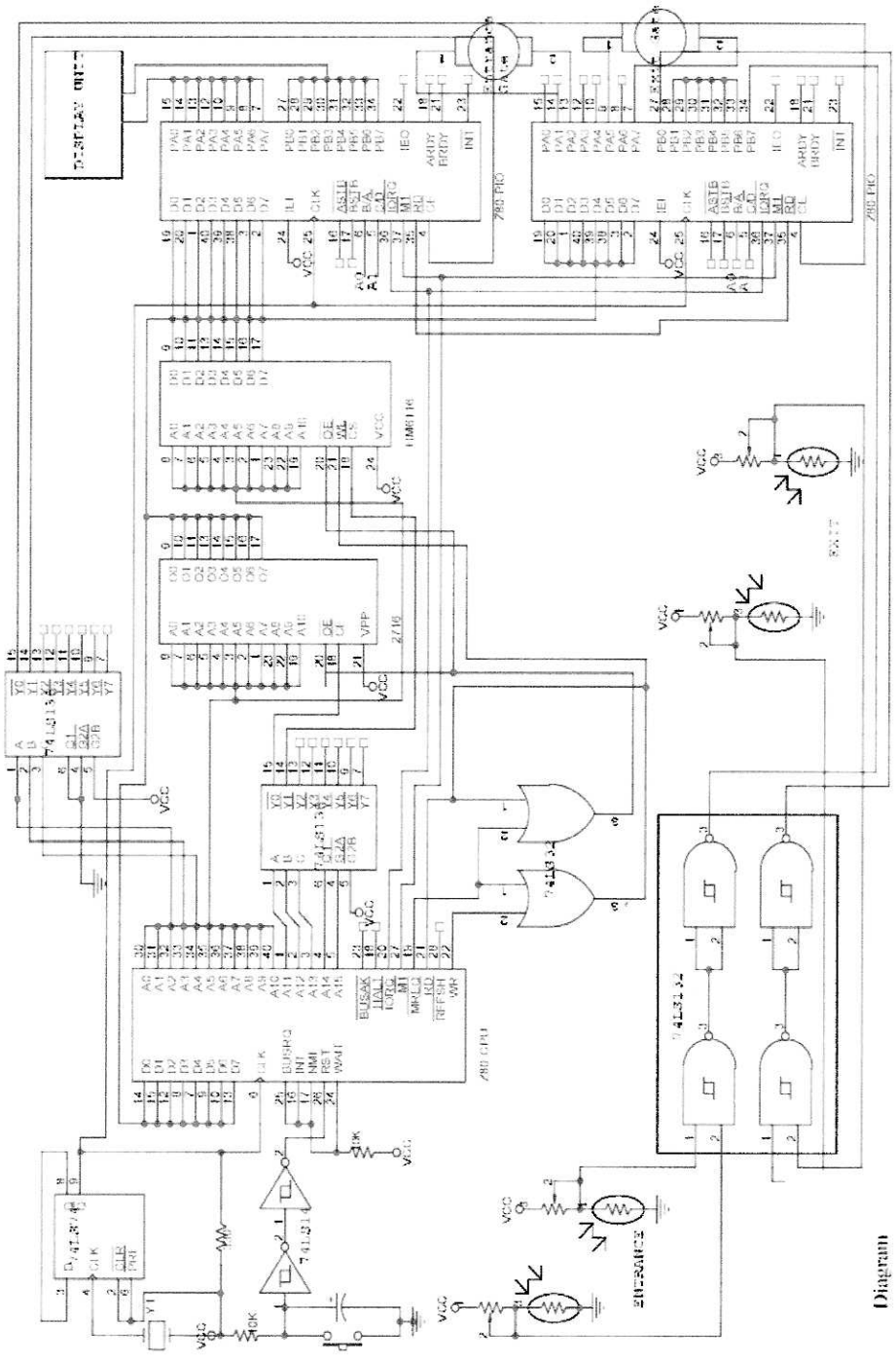

Figure 2.6 Main Circuit Diagram for Microprocessor Based Automatic Gate.

2.3 A Microprocessor-Based Gate Security System.

A microprocessor-based security system for gate control in a housing estate is described in this paper. The system provides efficient gate access and estate control to perform the job of the gate security guard. The hardware and software development of this system is presented.

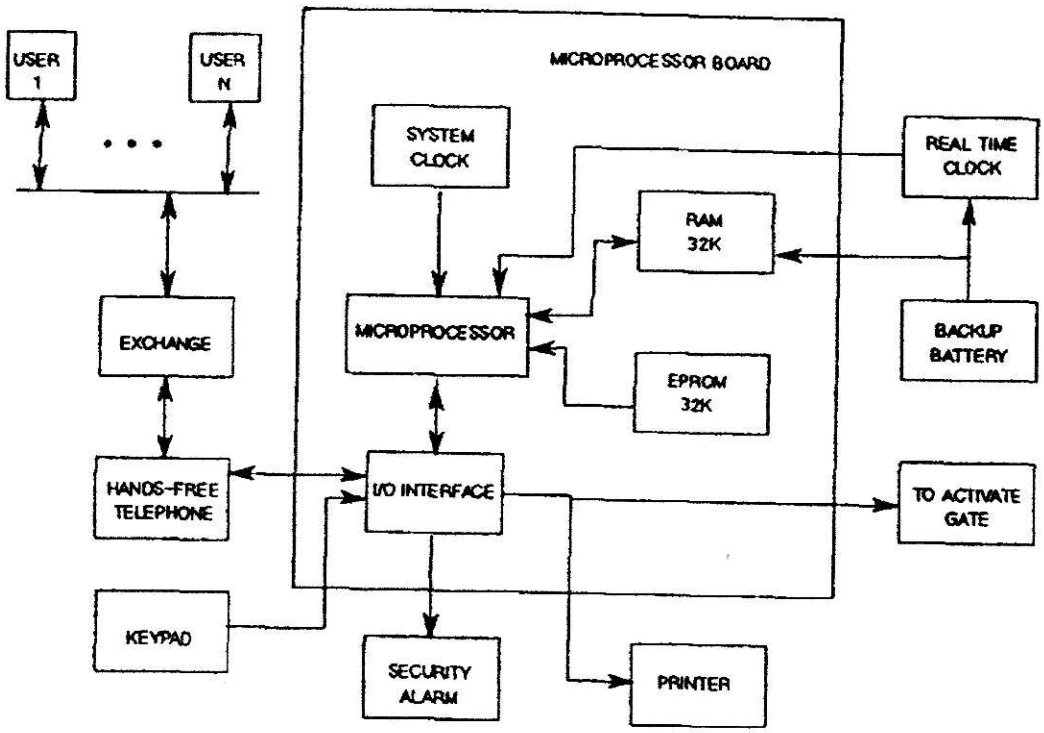

Figure 2.7 Block Diagram of Gate Security System.

Figure 2.7 Block Diagram of Gate Security System. Microprocessor is the main part of the block diagram that functions is to control the whole of the system. In this module, the program prompts the tenant for the access code. A check is then made and if valid, the program requests for the identification code. The gate is then opened once this code is verified. This mode also offers the facility to check if the access or entry is of a forced or threatened nature. An alarm code that is appended to the tenant code can be keyed in to alert the security personnel in such situations. The visitor mode is provided

for in Module 4. It displays the appropriate prompts to guide the visitor, performs the address translation to retrieve the telephone number, generates the dual tone timing for auto-dial to the unit concerned, and controls the up/down hook status of the telephone. In addition, this module provides a continuous background beep to indicate calls from the gate and accepts the generated key code from the tenant to acknowledge the identity of the visitor before the gate is opened.