



UNIVERSITI TEKNIKAL MALAYSIA MELAKA (UTeM)

A MODEL OF TRAFFIC LIGHT SYSTEM BY THE APPLICATION OF PLC

Thesis submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
Bachelor of Manufacturing Engineering (Robotics & Automation)

By

ZARIZAL BIN EDDY

B 050410157

Faculty of Manufacturing Engineering

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ABSTRACT

The project that was developed is “A model of traffic light system by the application of PLC”. This is one of the applications from the existing traffic light system in Malaysia. This model is integrated with PLC Keyence KV series. It uses three PLC which every PLC have ten input and six output. For this model it uses two input and eighteen output. It have start button to start operating the system and stop button to terminate the operation of the system. The system can be monitor on control panel because the path that moving will be indicate by the indicator light for every traffic light 1, traffic light 2, traffic light 3 and traffic light 4. This application is come from the sequence that been program in PLC by ladder diagram. To implement the development of this prototype, many steps have to perform. Starts with project planning, information searching and then further with prototype construction, there are been manage well until the recent progression that lead the way to produce a final functional prototype of a model of traffic light by the application of PLC.. By analyze and study about the previous researches, its help more to understand the concept and the application to be use for this prototype. This Project can be categorized to three main criteria which is mechanical, electrical and programming.

ABSTRAK

Projek yang telah di bangunkan ini bertajuk “Satu model sistem lampu isyarat yang menggunakan aplikasi PLC. Model ini adalah terhasil daripada sistem lampu isyarat yang sedia ada di Malaysia. Model ini diintegrasikan dengan PLC siri Keyence KV. Sistem ini menggunakan tiga PLC yang mana setiapnya mempunyai sepuluh input dan enam output. Untuk model ini, ianya menggunakan keseluruhan dua input dan lapan belas output. Ianya mempunyai butang mula untuk memulakan operasi sistem dan butang berhenti untuk memberhentikan sistem. Sistem lampu isyarat ini dapat di perhatikan daripada kotak kawalan kerana laluan yang sedang bergerak akan dapat diperhatikan pada lampu penanda untuk laluan satu, laluan dua, laluan tiga dan laluan empat. Aplikasi di janakan melalui turutan yang telah di programkan pada PLC iaitu melalui gambarajah tangga. Untuk menghasilkan prototaip ini banyak langkah- langkah yang perlu di jalankan. Ianya bermula dengan perangkaan projek, carian maklumat dan seterusnya kepada pembinaan prototaip yang seperti yang di rancangkan sehingga terhasilnya model ini. Dengan mengkaji dan menganalisis daripada kajian sebelum ini ianya lebih membantu untuk memahami konsep dan aplikasi untuk digunakan bagi menghasilkan prototaip lampu isyarat ini. Projek ini boleh di bahagikan kepada tiga kategori utama iaitu mekainal, elektrik dan pemogramman.

CHAPTER 1

INTRODUCTION

1.0 Introduction

Traffic light which is one of the vital public facilities plays an important role to the road users. It will help to curb from accidents and gridlocks. This research exposed the operational of traffic light such as understanding the flow of the traffic system and the program itself. Traffic signal light is used to control the movement of vehicles and passengers, so that traffic can flow smoothly and safely. Traffic signal lights have been around for years and are used to efficiently control traffic through intersections. Although traffic signal lights are relatively simple and commonplace, they are critical for ensuring the safety of the driving area. The growing use of traffic lights attests to their effectiveness in directing traffic flow, reducing the number of accidents, and the most recently to their utility in controlling the flow of traffic through metropolitan areas when have been used together with computer systems.

Traffic signal lights will improve the road safety and reduce congestion by providing the signals orderly through junctions. Traffic control lights are provided for traffic control on streets and highways, especially at junctions. The traffic signals are cyclically displayed through a suitable timing and control mechanism. A traffic light has three colors which are red, yellow and green. Every color carries a certain sign. The red light means the road user has to stop driving and not crossing or pursuing the ride while the yellow light show that the road user has to ready to stop their ride. However if the user is too close to the line that is not safe for a stop they have to continue the ride. The

green light shows the road user can continue their journey only with the absence of any hindrance. Driving through a red light without justification may be a citation able traffic offense. The transition of the light is controlled by PLC to help the traffic movement run smooth from one direction to the other. PLC reduces traffic congestion especially in the morning and evening. Besides, it also helps to reduce the accident rate especially in town.

1.2 Problem Statement

According to Kok, K. T. *et al* (1996a), the monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority or the Transport Ministry as the authority has to find new ways or measurements of overcoming this kind of problem. The measures had be taken were development of new roads and flyovers in the middle of the city, building of several ring such as the inner ring road, middle ring road and outer ring road, introduction of city trains such as the light rapid transit (LRT), and monorails, restricting of large vehicles in the city during peak hours, and also development of sophisticated traffic monitoring and control systems. In the city of Kuala Lumpur, the registration of new vehicles each year increased by about twenty per cent. This increment is rather alarming and even with the development of the LRT and new roads other measures have to be stepped up and introduced as quickly as possible. In Kuala Lumpur the problem of traffic flow during peak hours has been under control by the city traffic police. Traffic management systems address the objective of reducing congestion, vehicle delay time, fuel consumption and pollution (Mariagrazia Dotoli, 2006a). The transition of the light is controlled by PLC to help the traffic movement run smooth from one direction to the other. There is little reason to automate the traffic light using PLC. Compare to the conventional control panel there is too much wiring work in the panel. Troubleshooting can be quite troublesome and may require a skillful person. Modification of control sequence or application can easily be done by programming through the console or computer software without changing I/O wiring, if no additional input or output devices are required. Drawings for conventional control panel are not updated over the years due to changes, it will causes longer downtime in maintenance and modification. Futhermore, machine downtime is usually long when problems occur, as it take a longer time to troubleshoot the control panel. In PLC system spare part or relays and hardware timers are greatly reduced as compared to conventional control panel. Then, power consumption can be quite high as the coil of conventional control panel consumes power (Omron, 2000a).

1.3 Aims/ Objective

The objective of this project is:

- To develop and design a traffic light system using PLC.
- Create prototype for traffic light model
- Develop ladder diagram using Keyence PLC

1.4 Scope

The scope of this project will be cover on the design and programming of a crossroad traffic light system. The design work will include the application of Solid work and Autocad software. On the programming part, programmable logic controller will be used to integrated with the hardware or model that will be develop.

1.5 Significant of Study

Traffic light is the common use in our journey. Experience and knowledge is required to explore this system. This project is the combination of three main engineering field which is mechanical, electric and electronic and computer programming. The usage of PLC in this project give an exposure on how to automate the system.

In construction the ladder diagram, creativity and innovativity are need to make a design although in creating design prototype. All the consideration must be count to complete this project. This system will be act as the countermeasure of traffic jammed at junction.

The combination of theoretical and hands on will exposing to the reality of the engineering world. This project also approach how to generate and get the information from many sources. It is also an approach to improve the communication skills to public due to the project. Based on the gantt chart, it will guiding on how to manage time and everything in scheduling to make the progress of project goes smoothly. This is

important to aim certain target by the end of every week. The important is on how to absorb the pressure regarding to complete the project and another task.

1.4 Conclusion

In this chapter, general introduction of the overall project was discussed which is including the introduction, problem statement, scope, and significant of the study. In introduction, the discussion more about the general introduction of traffic light system. Then, in problem statement, the discussion cover about the problem related to the world without the traffic light system. It also brief the important to automate the system using PLC. But the most important for this project is the scope for this project. This will be the main topic that will be cover for this project.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

This chapter will be cover on the specification for this project that will be study in depth. The study will be based on previous research by another person. There are few approach that have been used to study the details of this project. There are literature review, journal, articale, reference book, lecture notes, product manual and via surfing internet. This is main step to collect the idea from previous design. All the theories and technique will be learning here. The idea that was developed by another researcher is important to help in generating idea to complete the design, analysis and prototype.

2.1 PLC

2.1.1 Introduction

Programmable logic controller (PLC) define as “an electronic instrument that operate by digital signal where it is using programmable memory for storing instruction in the internal memory to execute certain function such as logic, sequence, timer, counter and arithmetic by control through the modules or digital output or analog output for kinds of machine or process” by National Electrical Manufacturer Association U.S (NEMA).

First Programmable Logic Controllers (PLC) were designed and developed by Modicon as a relay re-placer for GM and Landis. These controllers eliminated the need for rewiring and adding additional hardware for each new configuration of logic. The new

system drastically increased the functionality of the controls while reducing the cabinet space that housed the logic. The first PLC, model 084, was invented by Dick Morley in 1969. The first commercial successful PLC, the 184, was introduced in 1973 and was designed by Michael Greenberg (Howard Hendricks, 1996).

PLC is an industrial computer that receives inputs from switches and sensors, evaluates these inputs in accordance with programmed instructions, and controls output devices based on the results of this evaluation (Bern and Olsen, 2002). According to Gustafson & Morgan (2004), the PLC works by looking at its inputs and depending upon their state, turning on/off its outputs. The user enters a program, usually via software, that gives the desired results.

PLCs have replaced hard-wired relay-based control systems in most industries because of their compact size, ruggedness, and, most importantly, their ability to be reprogrammed. Reprogramming a PLC allows changes to be made in the functional operation of a machine system without major physical changes in the control or output system components or wiring (Cox, 2001). Thus, labor, equipment, and downtime costs are reduced.

The automotive industry is still one of the largest users of PLCs. PLCs are used in many different industries and machines such as packaging and semiconductor machines. Well known PLC brands are Allen-Bradley, Mitsubishi Electric, ABB Ltd., Koyo, Honeywell, Siemens, Modicon, Omron, General Electric, and Panasonic (a brand name of Matsushita).

2.1.2 Features

The main difference from other computers is that PLC is armored for severe condition (dust, moisture, heat, cold, etc) and has the facility for extensive input/output (I/O)

arrangements (W. Bolton, 2000a). These connect the PLC to sensors and actuators. PLCs read limit switches, analog process variables (such as temperature and pressure), and the positions of complex positioning systems. Some even use machine vision. On the actuator side, PLCs operate electric motors, pneumatic or hydraulic cylinders, magnetic relays or solenoids, or analog outputs. The input/output arrangements may be built into a simple PLC, or the PLC may have external I/O modules attached to a computer network that plugs into the PLC.

According to W. Bolton (2000b), PLCs were invented as replacements for automated systems that would use hundreds or thousands of relays, cam timers, and drum sequencers. Often, a single PLC can be programmed to replace thousands of relays. Programmable controllers were initially adopted by the automotive manufacturing industry, where software revision replaced the re-wiring of hard-wired control panels when production models changed.

The actual PLC hardware typically consists of an industrially hardened rack mount system that contains plug-in modules for various functions; the power supply (commonly 12 to 24 VDC), the main processor module, various Input and Output modules, and possibly a communication module for networked systems. Connections between the I/O and the PLC are typically made via banks of screw terminals on the I/O modules. Typical Inputs to a discrete PLC system include limit switches, proximity switches, photo-detector switches, pulse encoders, and other ON/OFF type signals. Inputs from these different devices are effectively open or closed switches - regardless of the type of sensing being performed. These Inputs are powered by the PLC power supply and feed a voltage signal into the PLC (e.g. 0VDC = OFF /24VDC = ON). Typical Outputs from a PLC include relay contacts, triacs, or open collector transistors. In many applications, the PLC outputs are connected to larger current handling slaved devices such as motor starters, contactors, or relays which in turn control high voltage/current loads.

Many of the earliest PLCs expressed all decision making logic in simple ladder logic which appeared similar to electrical schematic diagrams. The electricians were quite able to trace out circuit problems with schematic diagrams using ladder logic. This

program notation was chosen to reduce training demands for the existing technicians. Other early PLCs used a form of instruction list programming, based on a stack-based logic solver.

The functionality of the PLC has evolved over the years to include sequential relay control, motion control, process control, distributed control systems and networking. The data handling, storage, processing power and communication capabilities of some modern PLCs are approximately equivalent to desktop computers. PLC-like programming combined with remote I/O hardware, allow a general-purpose desktop computer to overlap some PLCs in certain applications (Hackworth, J.R. & Frederick, 2004a).

The integration of robotics, conveyors, sensors, and programmable logic controllers into manufacturing and material handling processes requires engineers with technical skills and expertise in these systems. The coordination of assembly operations and supervisory control demands familiarity with mechanical and electrical design, instrumentation, actuators, and computer programming for successful system development (Hany Bassily *et al*, 2007a).

2.1.3 Recent project using PLC

According to S. Abdallah & S. Nijmeh (2003), an electromechanical, two axes sun tracking system is designed and constructed. The programming method of control with an open loop system is employed where the programmable logic controller is used to

control the motion of the sun tracking surface. Closed loop systems with photosensors are traditionally used as the main method of control of sun tracking systems. The photosensors are used to discriminate the sun's position and to send electrical signals proportional to the error to the controller, which actuates the motors to track the sun.

S. Bostyn *et al*, (2000) was develop the use of agricultural raw materials, permitting reduction of CO emission to have some biodegradable product, requires the development of an R&D process. The purpose is to find new natural compounds for innovative application. One of the laboratory research fields is the valorization of phytomolecules. The objective of work is mainly to isolate a family of compounds from the multitude of natural compounds composing vegetable matter using a process suitable on an industrial scale. Therefore, the process decided to be automating the unit operations. The benefits of this robotization will be to increase throughput while recording the value of process data. In other respects, robotization permits a decrease in the size of the reactor (1L to 10 mL) and this decreases the experimental cost, especially when the new natural compounds are available on the market (analytical market). The extraction module is controlled by logical information: output for electro valves, input for sensor, and timers. This will use opted for a CQM1 controller (Omron). It has 16 inputs, 32 outputs, 64 timers and a serial port (RS232). The serial port permits programming by software (Syswin) data exchange with SCADA.

The first PLC programming experiment is control of an Allen–Bradley industrial light stack (855E), which features red, amber, and green 24VDC lamps with an audible alarm. These devices can be used for many purposes in a manufacturing process such as signaling whether the system is ready, busy, or at fault. For this initial “on/off” experiment, though, the lamps are programmed for a traffic light sequence (Hany Bassily et al, 2007b).

2.2 TRAFFIC LIGHT

2.2.1 Introduction

Traffic light, also known as a traffic signal, stop light, stop-and-go lights, robot or semaphore, is a signaling device positioned at a road intersection, pedestrian crossing, or other location in order to indicate when it is safe to drive, ride, or walk using a universal color code (and a precise sequence, for those that are color blind).

The first four-way traffic signal tower in the world was located at the Woodward and Michigan Avenue intersection in October, 1920. The tower was manually operated and had 12 lamps, three in each direction. In December, 1920, signals were added along Woodward Avenue at Grand River, State, Fort and Congress, but all were controlled from the manual tower at Woodward and Michigan (Sheldon Moyer, 1988a).



Figure 2.1: The first signal tower with automatic lights, at Michigan and Woodward

Source: Sheldon Moyer (1988).

The first traffic lights had only four-inch lenses and the shell was wood with a tin cover. An original lamp was presented to Henry Ford's collection of Americana at the Edison Institute, Greenfield Village, in 1938 (Sheldon Moyer, 1988b).

In the late 1990s, a national standardization effort known as the advanced transportation controller (ATC) was undertaken in the United States by the Institute of Transportation Engineers. The project attempts to create a single national standard for traffic light controllers. The standardization effort is part of the National Intelligent transportation system program funded by various highway bills, starting with ISTEA in 1991, followed by TEA-21, and subsequent bills. Since the 1980s, some traffic signals have switched to computer-based controllers.

Mobility is nowadays one of the most significant ingredients of a modern society. For security, high-speed vehicles are controlled by traffic lights to move together with normal-speed vehicles. Vehicular traffic is optimized by traffic control strategy. Also, vehicular traffic is controlled by traffic lights to give priority for a road because the city traffic networks often exceed the capacity (Takashi Nagatani, 2005a).

2.2.2 Features

Light emitting diode (LED) lamps have been developed to replace conventional incandescent or fluorescent lamps for reducing electrical and maintenance costs, and for increasing reliability. LEDs offer the considerable advantage of consuming significantly less power than incandescent lamps. An LED traffic light uses only a fraction of the electrical power a light bulb traffic light used and is thus less expensive for long term use. In most cases, an LED array will consume about one tenth the powers that a filtered incandescent bulb will consume to produce the same light output. The life cycle costs of a traffic signal using an LED array in lieu of an incandescent bulb is also significantly reduced since incandescent bulbs used in traffic signals typically must be replaced once or twice a year.

A well designed LED array could be expected to function for more than twenty years before requiring replacement. LED lamps also generally require less frequent replacement due to burn out than incandescent lamps. The LED array is more resistant to the elements and is more mechanically durable than an incandescent bulb. It is also

possible to achieve a higher flashing rate with an LED array than with an incandescent bulb. LED lamps typically include a power supply and a plurality of LEDs mounted on a flat or curved surface. An LED array does not require a light reflector like the relatively large parabolical reflectors used with incandescent bulbs. The elimination of the reflector is an advantage because during certain seasons at certain times of day, sunlight can be reflected off the reflector in an incandescent bulb traffic signal and cause a confusing display.

2.2.3 Recent project using Traffic light

With the aluminum die casting shell and special honeycombed compound eyes optical system, LED traffic signal lamps are outstanding with good visual angle, equal light intensity, standard chromatogram and long service time. Human-based design, the lamp is easy for dismounting, installation and debugging. It uses high reliable LED ensured by strict aging test. Every LED is exceptionally exchangeable (MPKB, undated).



Figure 2.2: Traffic light model

Source: MPKB (2006)

Features:

- 1) Materials: die-casting aluminum
- 2) Luminous intensity (cd/m²): arrow $\geq 4,000$, round ≥ 400
- 3) Operating voltage: AC220V

- 4) Chromaticity:
 - a) R: 618nm - 630nm
 - b) G: 495nm - 508nm
 - c) Y: 585nm - 598nm
- 5) IP standard: IP53
- 6) Dimensions of light: φ 300mm, φ 400mm

2.3 RECENT PROJECT

2.3.1 Intelligent Traffic Lights Control by Fuzzy Logic

According to Kok, K.T. *et al.* (1996b), they describes the design and implementation of an intelligent traffic lights controller based on fuzzy logic technology. Software has been developed to simulate the situation of an isolated traffic junction based on this technology. It is highly graphical in nature, uses the Windows system and allows simulation of different traffic conditions at the junction. A comparison can be made between the fuzzy logic controller and a conventional fixed-time controller. Simulation results show that the fuzzy logic controller has better performance and is more cost effective.

Fuzzy logic traffic lights control is an alternative to conventional traffic lights control which can be used for a wider array of traffic patterns at an intersection. A fuzzy logic controlled traffic light uses sensors that count cars instead of proximity sensors which only indicate the presence of cars. This provides the controller with traffic densities in the lanes and allows a better assessment of changing traffic patterns. As the traffic distributions fluctuate, the fuzzy controller can change the signal light accordingly (Kok, K.T. *et al.*, 1996c).

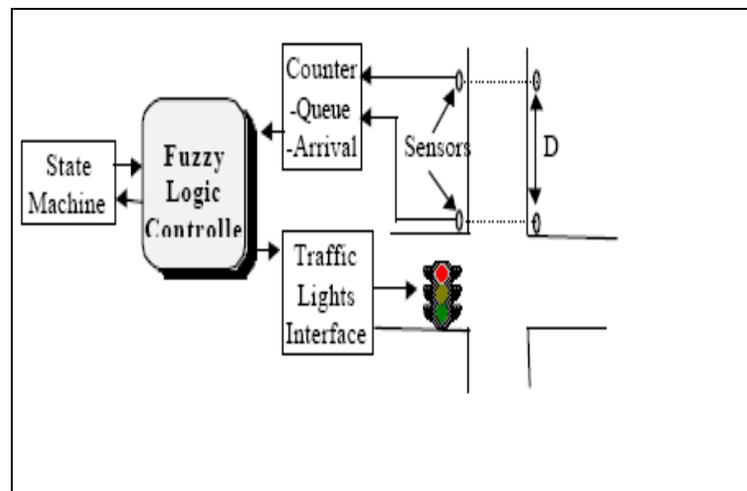


Figure 2.3: A general structure of the fuzzy traffic light control system

Source: Kok, K.T. *et al* (1996).

2.3.2 Majlis Perbandaran Kota Baru

Accoring to MPKB (undated), it show the real system of traffic lightin this country. Figure D uses a sensor to track down vehicles. Every direction of the traffic light is

provided with a sensor. The sensor (induction loop) functions when a vehicle crosses it. For instance, before a vehicle crosses the sensor it opens and once the vehicle runs crossing it, the device closes. The sensor functions every time and it will be more active in the morning and evening when the road is fraught with vehicles.

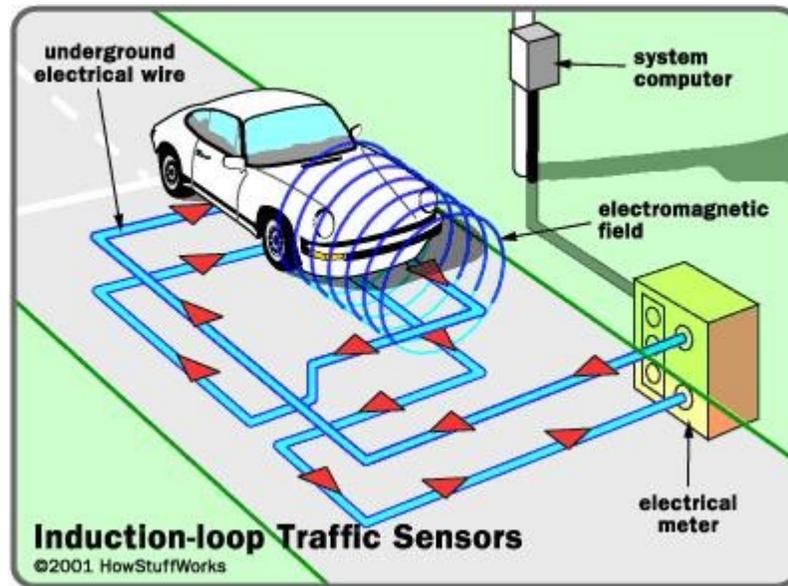


Figure 2.4: Induction loop traffic sensors. How red camera works[Online].

Available :<http://auto.howstuffworks.com/red-light-camera1.htm> [September 15,2007]

It constantly tests the inductance of the loop in the road, and when the inductance rises, it knows there is a car waiting. When current first starts flowing in the coil, the coil wants to build up a magnetic field. While the field is building, the coil inhibits the flow of current. Once the field is built, then current can flow normally through the wire. When the switch gets opened, the magnetic field around the coil keeps current flowing in the coil until the field collapses. This current keeps the bulb lit for a period of time even though the switch is open.

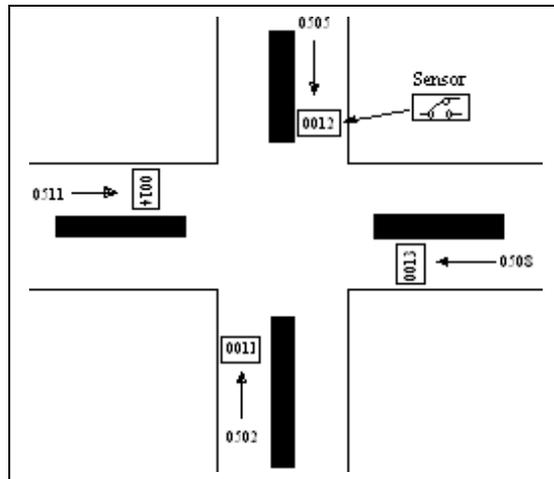


Figure 2.5: The traffic light that uses the sensor

Source: MPKB(2006).



Figure 2.6: Main Switch Board and Controller System

Source: MPKB (2006)



Figure 2.7: PLC Controller System

Source: MPKB (2006)



Figure 2.8: Metal Detector Sensor under the Road Pavement

Source: MPKB (2006)

2.3.3 Control of vehicular traffic through a sequence of traffic lights positioned with disordered interval

According to Takashi Nagatani (2005b), the study is about dynamical behavior of vehicular traffic through a sequence of traffic lights which are positioned with in homogeneous interval on a roadway and turn on and off periodically with the synchronized strategy. The dynamics of vehicular traffic controlled by traffic lights is described in terms of the stochastic nonlinear map. When the interval between traffic lights fluctuates highly, vehicles cannot move together with the same tour time. Vehicles can move together with the other at less inhomogeneous interval between traffic lights for specific values of cycle time. If heterogeneity of traffic-light's interval is higher, it becomes more difficult to control vehicles moving together.

2.3.4 An urban traffic network model via colored timed Petri nets

Mariagrazia Dotoli (2006b), deals with modeling of traffic networks (TNs) for control purposes. A modular framework based on colored timed Petri nets (CTPNs) is proposed to model the dynamics of signalized TN systems, places represent link cells and crossing sections, tokens are vehicles and token colors represent the routing of the corresponding vehicle. In addition, ordinary timed Petri nets model the signal timing plans of the traffic lights controlling the area. The proposed modeling framework is applied to a real intersection located in Bari, Italy. A discrete event simulation of the controlled intersection validates the model and tests the signal timing plan obtained by an optimization strategy.

2.4 CONCLUSION

In this project, the approach that been used consist of three main engineering field, which is mechanical, electric and electronic and computer programming. This project can be classified as easy for certain people. But, there a lot of explicit explanation inside this project. The PLC give a lot advantages based on the modification and troubleshoot. All the consideration of I/O should be determine before start with the programming. Base on previous project, the timing and the sequence of traffic light must be identify to make sure the traffic flow smoothly. Instead, the fuzzy logic also apply in consideration of timing and flow traffic. It use the coil sensor to integated with the PLC application. But to apply this design, the money will be one of the constrain for this project. I also have the system of traffic light that we use today in our country. All of this information was gathered when Practicalling Trainning in Majlis Perbandaran Kota Baru. The system also use the same fuzzy logic system. It use Artificial Inteligent to intergrate with traffic light system. It use to control the flow based on distribution.

Now on, futher concept about this three main field has been explore. From the effort has been made, the data gained will be exposed to come up with the design and analysis. Here, all the theoris and previous design will be apply to get the best design.

CHAPTER 3

METHODOLOGY

3.0 INTRODUCTION

Methodology can be defined as a body of practices, procedures, and rules used. People who work in a discipline or engage in an inquiry; methodology known as a set of working methods. The methodology of genetic studies was a poll marred by faulty methodology.

Methodology includes the following concepts as they relate to a particular discipline or field of inquiry:

- 1) a collection of theories, concepts or ideas
- 2) comparative study of different approaches
- 3) critique of the individual methods

In this chapter, the explanation will be roughly about how to setup the project. It will be start with the approach that will be used. Then follow up by development phases, tools and techniques, PLC versus other controller. The process flow and design requirement for this project will be explain in this chapter.

3.1 Programming approach

Programs for microprocessor based system have to be loaded into them in machine code, this being a sequence of binary code numbers to represent the program instructions. However, assembly language based on the use of mnemonics can be used, e.g. LD is used to indicate the operation required to load the data that follows the LD, and a computer program called an assembler is used to translate the mnemonics into machine code. Programming can be made even easier by the use of the so called high level language, e.g. C, BASIC, PASCAL, FORTRAN, and COBOL. These use pre packaged functions represented by simple words or symbols descriptive of the function concerned. For example, with C language the symbol & is used for logic AND operation. However, the use of these methods to write programs requires some skill in programming and PLCs are intended to be used by engineers without any great knowledge of programming. As consequence, ladder programming was developed. This is a means of writing programs which can then be converted into machine code by some software for use by the PLC microprocessor (W. Bolton, 2000).

When writing programs for PLCs, it is beneficial to have a background in ladder diagramming for machine controls. This is basically the material. The reason is that, at a fundamental level, ladder logic programs for PLCs are very similar to electrical diagrams. This is not coincidence. The engineers that developed PLC programming language were sensitive to the fact that most engineers, technicians and electricians who work with electrical machines on a day to day basis would be familiar with this method of representing control logic. This would allow someone new to PLCs, but familiar with control diagrams, to be able to very quickly adapt to the programming language is one of the easiest programming languages to use (Hackworth, J.R. & Frederick, 2004b).

3.2 DEVELOPMENT PHASES

3.2.1 Project Gantt chart

Title

• A MODEL OF

Supervisor

: MR. KUZAWI ZAVIN

Gantt chart

Activity description	Week 1	Week 2	Week 3	Week 4
Title				

Table 3.1: Gantt chart

Gantt chart PSM 2

Activity Description	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16
Material Selection	■	■														
Prototype Development			■	■	■	■	■	■	■	■	■	■	■	■		
Prototype Testing											■	■	■	■	■	
Project Analysis											■	■	■	■	■	
Report Progression					■	■	■	■	■	■	■	■	■	■	■	
Draft Submission																
Report Submission															■	
Presentation and Project Demonstration																■

Table 3.2: Gantt chart for PSM 2

