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THE TRAFFIC LIGHT CONTROL SYSTEM

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ABSTRACT

Traffic congestion has become problem not only in town but also at housing area and sub-urban. This problem due to the rapid increase in the number of vehicles. The objective of this project is to develop a traffic light system base on a real traffic light. This system is design to control and to make sure the smoothness of the traffic during peak hour. This model using PLC as a controller. The dc power supply is responsible to give input signal to the PLC. The presence of vehicle during traffic jam will be sense by switch. When the switch is close the power supply circuit is in close circuit. For normal condition, vehicle won't trigger the sensor. So, sensor wills not operate.

ABSTRAK

Kesesakan lalulintas telah menjadi satu masalah bukan sahaja dibandar tetapi juga di kawasan perumahan dan pinggir bandar. Masalah ini berpunca dari pertambahan bilangan kenderaan yang digunakan dijalan raya. Objektif projek ini adalah untuk menghasilkan sebuah model berpandukan pada lampu isyarat yang sedia ada. Sistem ini berfungsi untuk mengurangkan kesesakan jalan raya semasa masa puncak. Pada bahagian input PLC, sumber kuasa DC digunakan untuk membekalkan 24V arus terus. Sensor akan dinyalakn sekiranya terdapat kenderaan diatasnya, dimana ia berfungsi seperti suis. Tetapi untuk keadaan normal tidak berlaku perubahan atau penambahan masa.

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CHAPTER 1

PROJECT BACKGROUND

1.1 Introduction

The traffic light system using Programmable Logic Control (PLC) is another way of reducing the traffic jam. This system controls and maintains the smoothness of the traffic flow in the housing and sub-urban areas.

Towards the use and develop the traffic light control system it also means that all decisions are made by the computer. Timer will be replaced with the PLC. The whole process of the system will be monitored and controlled by the PLC. This system will be able to increase efficiency over the time and cost spent on the road as compared with the other systems.

1.2 Objectives

The objectives of this project are to build a hardware model based on the real traffic condition and using PLC as the controller, to develop a program or a ladder diagram using the CX-Programmer for the PLC. This model will be able to maintain and control the flow of the traffic by passing more cars if there are more vehicles waiting behind the red lights.

1.3 Problem Statement

The present systems used mostly operate using the timer that has been set earlier without identifying which road having the heavy traffic.

For normal situation, there will be no problem with this type of system. But in some conditions, the problem occurred when there are sudden changes of the traffic flow on the road. The traffic light will not be able to maintain the smoothness of the traffic flow, thus it caused the traffic-jammed.

To overcome this problem, usually the police traffic is needed to conduct the traffic. However, this is not a good solution to reduce the traffic-jammed problem. So, the new traffic light system will be implemented and to replaced the present system in order to maintain the smoothness of the traffic flow.

Other problems faced with the conventional systems are as follows;

a) Traffic lights are changed after a constant cycle time, which does not result in the most optimal solution. Take an example, the traffic flow on the two ways changes radically depending on the time of the day. This system would not pass more cars at the green interval if there were more vehicles waiting behind red light.

b) When there is no changing of time especially during peak hours heavy traffic will happen. So, this system still requires police traffic when traffic lights failed to perform it task. It is not practical when we still depend on the police traffic to control the traffic when we could use other methods to control the system.

1.4 Conclusion

It is important to determine the objective of this project and identify the problem statements. In order for this project to be completed, the objective must be understood clearly and also the design of the system needs to be studied before going any further.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Before starting the project, researches related with traffic light controller have been conducted. Besides PLC, there are also other control systems using different methods such as Fuzzy Logic and PID controller. There are many types of sensors could be used for example the infrared sensor, the movement sensor and the distance sensor. This chapter includes the researches that has been done and discuss the advantages and disadvantages of the system. Also included in this chapter is the benefit of the system that will be built, definition of each term and concept of the project.

2.2 Project Researches

Researches are used to gain ideas and information before the software and hardware of the system could be design. For the hardware part, the most important thing is to determine the type of sensor that will be used.

2.2.1 Fuzzy Logic and Traffic Light

Nelson Lai (1998) describes the design procedures of a real life application of fuzzy logic.The controller is supposed to change the cycle time depending upon the densities of cars behind green and red lights and the current cycle time. In a conventional traffic light controller, the lights change at constant cycle time, which is clearly not the optimal solution. It would be more feasible to pass more cars at the green interval if there are fewer cars waiting behind the red lights. Obviously, a mathematical model for this decision is enormously difficult to find. However, with fuzzy logic, it is relatively much easier.

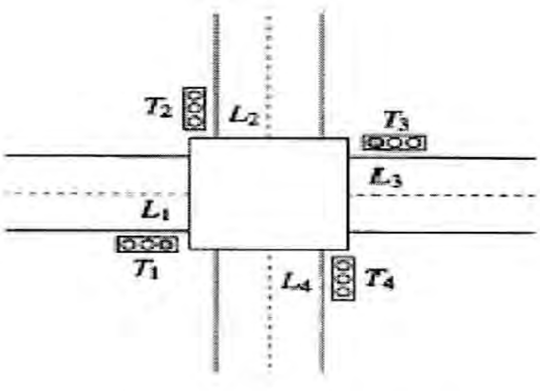

Figure 2.1: Traffic light at four junctions

The first sensor behind each traffic light counts the number of cars coming to the intersection and the latter counts the cars passing the traffic lights. The amount of cars between the traffic lights is determined by the difference of the reading of the two sensors. For example, the number of cars behind traffic light North is s7-s8. As before, firstly the inputs and outputs of the design has to be determined. Assuming red light is shown to both North and South streets and distance D is constant, the inputs of the model consist of :

1)Cycle Time
2)Cars behind red light
3) Cars behind green light

The cars behind the light are the maximum number of cars in the two directions. The corresponding output parameter is the probability of change of the current cycle time. Once this is done, the input and output parameters are divided into overlapping member functions, each function corresponding to different levels.

2.2.2 Intelligent Traffic Light Control

Traffic in a city is very much affected by traffic light controllers. It is a waste of time and fuel while stuck in the traffic-jammed. Ma[illegible]03) defined this proposed project exploit the emergence of novel technologies such as communication networks and sensor networks, as well as the use of more sophisticated algorithms for setting traffic lights. Intelligent traffic light control means that traffic lights are set in order to minimize waiting times of road users.

Suppose there are a number of cars with their destination address standing before a crossing. All cars communicate to the traffic light their specific place in the queue and their destination address. Now the traffic light has to decide which option (i.e. which lanes are to be put on green) is optimal to minimize the long-term average waiting time until all cars have arrived at their destination address. The learning traffic light controllers solve this problem by estimating how long it would take for a car to arrive at its destination address when currently the light would be put on green, and how long it would take if the light would be put on red.

The difference between the waiting time for red and the waiting time for green is the gain for the car. Now the traffic light controllers set the lights in such a way to maximize the average gain of all cars standing before the crossing. To estimate the waiting times, the proposed system use 'reinforcement learning' which keeps track of the waiting times of individual cars and uses a smart way to compute the long term average waiting times. The system will not allow a car waits for a certain time, since then its gain of setting its own light to green becomes very large, and the optimal decision of the traffic light will set its light to green.

2.2.3 Fuzzy Traffic Light Controller

Dr. Devinder Kaur, Elisa Konga, Esa Konga (1995) describe the design of Fuzzy traffic controller at the intersection of two streets which changes the cycle time depending upon densities of cars behind green and red light and the current cycle time. A fuzzy model of the system has been built and tested to predict the behavior of the model under different traffic conditions.

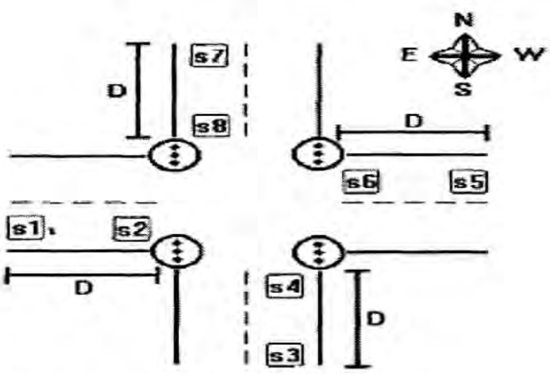

Figure 2.2: Traffic light

The design has been implemented by using sensors as shown in figure 2.2. The first sensor behind each traffic light counts the cars coming to the intersection area and the last one counts the cars passing traffic lights. So, every time a car passes the incremental sensor, the sensor increments its value by one. The amount of cars behind the traffic light between the two sensors is the difference in the two readings.

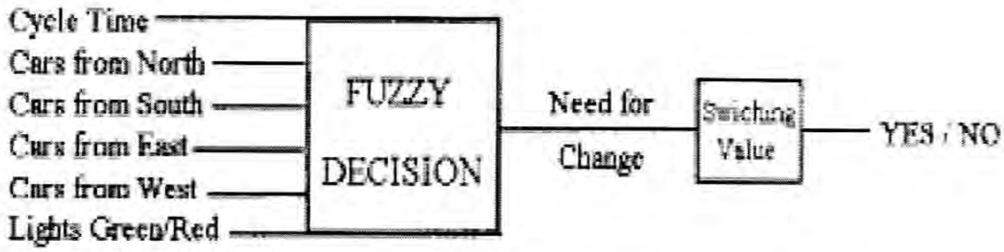

Figure 2.3: Operating diagram of Fuzzy

This system operated by counting whenever a car passes over it. There are 3 steps for Fuzzy decision processing:

1. Fuzzification(Using membership functions to graphically describe a situation)
2. Rule evaluation(Application of fuzzy rules)
3. Defuzzification(Obtaining the crisp results)

2.2.4 Traffic Signal Control Using Fuzzy Logic

Qinghui Lin, B.W. Kwan and L.J Tung (1997) introduce a versatile traffic flow model capable of making optimal traffic predictions. It can be used to evaluate various traffics-light timing plans. This journal proposes a two stage strategy to develop an almost optimal adaptive traffic controller using fuzzy logic.

The first stage, a dynamic model is used to accurately predict traffic flow at an intersection based on the optimal plans. Then, input- by the dynamic model are then used in the implementation of a fuzzy model are then used in the implementation of a fuzzy system. This fuzzy system is designed to approximately the optimal timing plan for an arbitrary traffic flow condition on a real-axis basis.

2.2.5 Optimal Traffic Light Control for a Single Intersection

Bart De Schutter (June 1997) tried to solve optimal traffic light control problem for an intersection of two-way streets. The approximate model describes the evolution of the queue lengths as a continuous function of time. Starting from the model data then is compute to minimize average queue length, average waiting time etc. special class of objectives functions an optimal traffic light switching scheme can be computed very efficiently.

Designating optimal traffic light switching schemes is only useful if the arrival and departure rates of vehicles at the intersection are high. Approximation queue lengths by continuous variables only introduce small errors. Furthermore, there is also some uncertainty and variation in time of the arrival and departure rates, which makes that in general computing the exact optimal traffic light switching. The main purpose of this journal is to design of optimal traffic light traffic light switching schemes, then assuming that the average arrival and departure rates are constant in each phase.

2.2.6 Electro Sensitive Traffic Light Using Fuzzy Neural Network

To overcome the problem of conventional traffic signal, the traffic signal must reduce the average vehicle waiting time. Traffic signal cycle optimization is one of the most efficient ways for reducing fuel consumption and improving vehicle waiting time. This system uses an electro sensitive traffic light control, which changes signal based on the passing vehicle weight, length and passing area.

An electro sensitive traffic light system can extend the traffic cycle when many vehicles are on the road or it can reduce the traffic cycle when there is a small number of vehicles on the road. It is important to know is it true that the road is heavily traffic, taking an example of lorry. The length of lorry doubles the size of car. But the disadvantages of this system are, mistakes can easily occur due to changes in car weight, speed and passing area.

2.2.7 Sensor

M.A.G Clark, A. Hodge and P. Kidson (1995) explain about two types of sensor; active and passive. Currently, sensor for traffic light being implied in western especially in sub-urban area. This journal also explains the sensor that utilities the infrared wavelength of the electromagnetic spectrum.

For passive vehicle detector, this unit primarily intended for mounting on signal heads at intersections to detect vehicles. Detector responses to heat energy emanating from the object that is to be detected. This device is responsive in the 6 to 14 um region of the electromagnetic spectrum which corresponds to the wavelength of emissions from targets such as humans and motorized vehicles. In operation vehicles approaching the detector are focused by a multi-faceted Fresnel lens array onto a sensor matrix. Advantages using this sensor are:

i. Well defined direction locations, there detectors are easily aligned to prevent detection on opposite carriageways. The detection zones have been chosen to correspond to the commonly encountered "system D' loop sitting.

ii. Entirely Passive

iii. Reliability- The unit is of entirely solid stat design. The primary sensor is conducted from a ceramic material encapsulated in a hermetically scaled package intended for applications in adverse environmental conditions.

For active vehicle detector, this unit is intended on an overhead gantry or similar platform. The detector is based on a transmitter and twin receiver enclosed in a single housing. The transmitter and twin receiver enclosed in a single housing. The transmitter sections emit encoded streams of infrared light into two regions along the road.