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# PLC Based Smart Traffic Light Control

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**ABSTRACT**

**The scope of this paper is to present the initial steps in the implementation of a smart traffic light control system based on Programmable Logic Controller (PLC) technology. We, in this method, intend to measure the traffic density by counting the number of vehicles in each lane and their weight, then park in automated parking or diverge them accordingly. It is also difficult for a traffic police to monitor the whole scenario round the clock. So, this system can be implemented on highways and city traffic. The current traffic control system is generally controlled by using microcontrollers and timers. In the case of these systems, there are many drawbacks related with analysis and monitoring of traffic control system. By using programmable traffic control system, we can manually adjust the timers of the signal. We are trying to establish centralized PLC based traffic control system. The administrator on central station computer can access any approachable traffic signal and nearby area to reduce traffic congestion. The application of this system will avoid traffic congestion, improve the efficiency of road and make a conservation of energy.**

**Keywords: Programmable Logic Controllers (PLC), sensor, Counters, LEDs, Relays, Switches, SMPS.**

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## I. INTRODUCTION

Traffic signals are the most convenient method of controlling traffic in a busy junction. But, we can see that these signals fail to control the traffic effectively when a particular lane has got more traffic than the other lanes. This situation makes that particular lane more crowdie than the other lanes. If the traffic signals can allot different lanes to different time.

Traffic load heavily relies on parameters such as time, day, season, weather and unpredictable situation such as accidents, construction activities. If the parameters are not taken into account, the traffic control system will create chaos. A traffic control system that minimizes these problems by continuously sensing and monitoring traffic conditions and adjusting the timer of traffic lights accordingly is called an intelligent traffic control system. Traffic control systems may also be classified as overcrowded or moderately crowded, depending on whether they were designed for an overcrowded or moderately crowded network. In a moderately crowded network, it is desired to minimize the mean delay of drivers, while in an overcrowded network it is intended to serve as many drivers as possible, or in other words, to maximize traffic capacity of the intersection. An intelligent traffic control system must be capable of identifying overcrowded conditions in the network and change the function accordingly. In fixed-timer systems, there were multiple timer plans, but an intelligent traffic control system can have various control strategies. We need to understand the function of traffic signals so that we can enhance driving habits by regulating the speed in order to reduce the number of related traffic accidents. A driver who knows about the operation of traffic signals, the less frustrated he is going to be while waiting for the traffic lights to change. The purpose of designing and developing the Intelligent Traffic Control System is to reduce the waiting time of each lane of the road and also to maximize the number of vehicles that can use the road. The Intelligent Traffic Control System consists of three main parts. The first part is the PLC controller. The second part is hardware, usually comprises of red, yellow, and green lights. And the third part is the sensors. The sensors check the presence of vehicle.[2]

In order to implement the applications indicated, a certain level of intelligence is required in both the traffic

 

light and the regulator. Traditional traffic control systems are unidirectional, from regulator to traffic lights, without any response from the status of the traffic lights [3]. A traffic light group is defined as a set of traffic lights which are controlled by the same regulator, which acts as a master or coordinator. The regulator operates under a intelligent system that allows for controlling the lights status depending on time, traffic conditions, etc. Urban traffic control strategies are based on lights controllers. An intersection is managed by a controller in charge of several red lights. The management is based on phases, cycles, split vectors and coordination between the controllers of the different intersections on the road network.

**Methods**

**I.Block Diagram:**

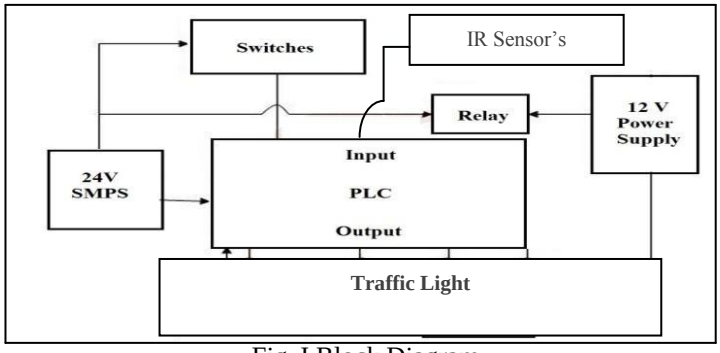


Fig. I Block Diagram

**II. Working**

Our focus is to control traffic signal by automation process. It is designed for both automatic and manual control if required. In this project, we are using Programmable Logic Controllers (PLC) and as automated devices.

In this model, all the inputs of traffic light indicators are given to the PLC and it is programmed according to which traffic Signals will operate. In the program, we have provided a specific time for a particular signal. The lights will glow according to the time which has been initially saved in PLC. The timer of the lights will vary according to the output of all the IR sensors. If the density of traffic is increased and if all IR sensors give output then timer count of the lights will increase by the defined time interval. If the traffic density falls in the normal range then the timer counter of traffic signal will work according to the initial count saved previously in PLC. We have control over traffic where the traffic flow is variable. We have placed sensors in each path of T point. Due to this the controller in the control room can rise the time for green indicator where the traffic flow is dense.

**III. ADVANTAGES**

- Minimizing unnecessary stop and start of traffic which reduces fuel consumption, air pollution, noise pollution and vehicle wear and tear.
- Improves journey time.
- Minimizing driver frustration and 'road rage'.
- Improving the traffic handling capacity of roads.[2]
- Encouraging travel within the speed limit to meet green lights.
- Minimizing collisions, and waiting time for both vehicle and pedestrian.[2]

**IV. STUDY OVERVIEW**

The study comprises of two main parts. The first part is the study of PLC and the second part is its application: Intelligent Traffic Control System. The Application is divided into two main parts, software part, and hardware part. Software part includes Ladder logic Programming technique. Hardware part includes PLC is used along with proto type hardware and IR sensors are used for sensing the presence of the vehicles on the square in proto type.

**A. Programmable Logic Controllers (PLCs)**

Programmable Logic Controllers (PLCs) is a microprocessor-based device used to control industrial processes or machines. It provides Avant grade functions, including analog monitoring, control, and high-speed motion control as well as share data over communication networks. PLCs are used in many industries and machines. [4] PLCs are used for multiple orders of digital and analog inputs and outputs, wide temperature ranges, immunity to noise, and resistance to vibration and impact. Programs to control machine functions are typically stored in battery-backed-up or non-volatile memory. Programs to control machine functions are typically saved in battery-backed-up or non-volatile memory. A PLC is a real-time system since output results must be generated in response to input fed within a limited time, or else unintended operation will result. [4] The PLC is communicating and highly productive in real-time mode. The consistent modular design allows the creation of tailor-made, expandable solutions in the low-end performance range. The PLC from Siemens can be used both as stand-alone Micro PLC solution and in concomitance with other controllers.

Fig. II PLC

**B. Ladder Programming**

Ladder logic has developed into a programming language that renders a program by a graphical diagram which is

 

based on the circuit diagrams of relay logic hardware. [4]Ladder logic is used to develop software for programmable logic controllers such as PLCs are used in industrial control functions. This name is formed on the observation that programs in this language bear a resemblance to ladders, with two vertical rails and a series of horizontal bars between them. While ladder diagrams were the only available notation for recording programmable controller programs .Ladder logic is widely used to program PLCs, where continues control of a process or manufacturing operation is required. Ladder logic is useful for simple but critical control systems or for revamping old hardwired relay circuits. As programmable logic controllers became more advanced it has also been used in very complex automation systems. Often the ladder logic program is used in concomitance with a human machine interface program operating on a computer workstation. In ladder programming logic, simple switch circuits are converted to relay logic and then to PLC ladder logic.

And = series connection of contacts
Or = parallel connection of contacts
On = normally-open contact
Off = normally-closed contact
These concepts are key to understand and write ladder logic. Ladder logic is a very visual and graphical language.

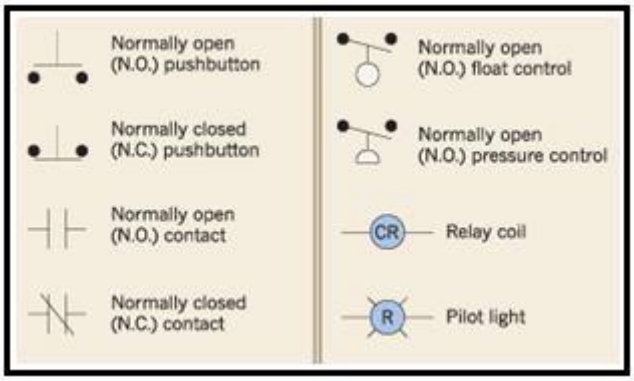


Table I Common symbols used in ladder programming

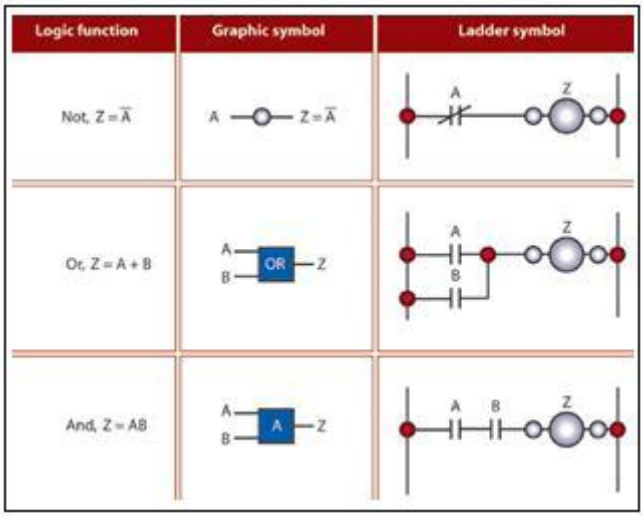


Table II Comparison of logic symbols

C.**IR Sensor**

A passive infrared sensor (PIR sensor) detects infrared radiation from objects in its range. It is often used in PIR based motion detectors. Objects with a temperature above absolute zero emit heat energy in the form of radiation. The human eye cannot detect this radiation because it radiates at infrared wavelengths, but it can be sensed by electronic devices designed for such detection purpose.

The term passive, in this case, refers to the fact that PIR devices do not produce any energy for detection purposes. They work entirely by detecting the energy emitted by other objects. It is significant to note that PIR sensors don't sense heat, instead, they detect the Infrared radiation given off from an object which is different from but often matches up with the object's temperature.

## DISCUSSION AND RESULTS

1. The results had been got from the practical application and the virtual program (Delta PLC) were the exactly same.
2. The same duty cycle of the traffic lights by using the PLC is realized as like in the traditional traffic lights method. So we can achieve a satisfactory performance operation at economical cost with the use of PLC.
3. The relinquishment of traditional contact device contributes to decrease the maintenance costs regarding to removing the contact parts.
4. The system failure and troubleshooting when using PLC is very low comparing with the classical method.
5. The timing modification of the traffic lights is very simple and easy, especially in the case of heavy traffic. The programming of PLC and timing change is very simple and could be done by an operator person, then we don‘t need a special high performance programmers.[1]

## CONCLUSION

An intelligent traffic control system was successfully designed and implemented. The sensors were interfaced with Lab PLC Module. With the advancement of the development of transportation, the rise in vehicles traffic is suffering from unprecedented challenges. The system can improve the efficiency of traffic control, as it is an intelligent traffic control system, so, it can itself adjust the time length of the traffic lights based on the road and seasonal changes, to reduce the crossroads vehicles stagnancy, relieve traffic jam and improve traffic control system optimal control.

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