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4 Ways Traffic Light Control Using Plc and Scada

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Abstract

The project entitled "4-Way Traffic Light Control Using PLC and SCADA" focuses on developing an automatic traffic signal control system for managing vehicle movement at a four-way road intersection. Traffic congestion and improper signal management can lead to delays, fuel wastage, and road accidents. To address these problems, the proposed system uses a Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) technology to control and monitor traffic signals efficiently

The proposed project demonstrates the practical application of industrial automation in traffic management. Future improvements may include vehicle-density sensors, adaptive signal timing, emergency vehicle priority, and backup power facilities. Overall, the integration of PLC and SCADA offers a useful foundation for developing more efficient, reliable, and intelligent traffic signal control systems.

In this system, the PLC acts as the main controller and operates the red, yellow, and green traffic lights for the North, South, East, and West directions according to a predefined sequence and timing program. The SCADA system is connected to the PLC through a communication interface and provides a graphical display of traffic signal status, timer values, and system operation. It also enables an operator to supervise the system and modify permitted settings when required.

The proposed project demonstrates the practical application of industrial automation in traffic management. Future improvements may include vehicle-density sensors, adaptive signal timing, emergency vehicle priority, and backup power facilities.

Keywords:

PLC, SCADA, Traffic Light Control, Four-Way Intersection, Indu- strial Automation, Traffic Management, Signal Timing.

1. INTRODUCTION

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Traffic management is an important part of modern transportation systems. With the continuous increase in the number of vehicles on roads, traffic congestion has become a major problem in urban and semi-urban areas. At road intersections, improper traffic signal timing can lead to long waiting times, fuel consumption, air pollution, and an increased risk of accidents. Therefore, an efficient and reliable traffic signal control system is required to manage vehicle movement and improve road safety.

The project "4-Way Traffic Light Control Using PLC and SCADA" aims to develop an automatic traffic signal control system for a four-way road intersection. The system controls traffic movement in four directions: North, South, East, and West. It uses a Programmable
‹Logic Controller (PLC) as the main control unit and Supervisory Control and Data Acquisition (SCADA) software for monitoring
and supervision. The PLC operates the red, yellow, and green traffic lights according to a predefined sequence and programmed time intervals.

The main objective of this project is to demonstrate how industrial automation technology can be applied to traffic signal management. The system aims to provide consistent signal timing, reduce manual intervention, and support safer traffic movement through correctly designed control logic. Although a basic fixed-time system cannot respond automatically to changing traffic density, future improvements can include vehicle sensors, adaptive signal timing, emergency vehicle priority, and backup power facilities.

In conclusion, the integration of PLC and SCADA provides a practical approach to designing an automated four-way traffic light control system. This project helps demonstrate the principles of industrial automation, sequential control, timer-based programming, and real-time monitoring.

2. BODY OF PAPER

The four-way traffic light control system using a Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) is designed to automate the operation of traffic signals at a road intersection. The system controls vehicle movement in four directions: North, South, East, and West. It uses a predefined control sequence to operate red, yellow, and green traffic lights at appropriate time intervals.

In the proposed system, the PLC acts as the main controller, while SCADA software provides a graphical interface for monitoring and supervision. The PLC executes the control program and activates
t‹he required outputs according to the programmed logic. SCADA
communicates with the PLC to display the current status of traffic signals, timer values, and operating conditions

The system can be implemented using a PLC controller, LED traffic lights, a regulated power supply, output driver circuits, communication cables, and a computer running compatible SCADA software. This hardware-based arrangement provides a practical demonstration of industrial automation in traffic management.

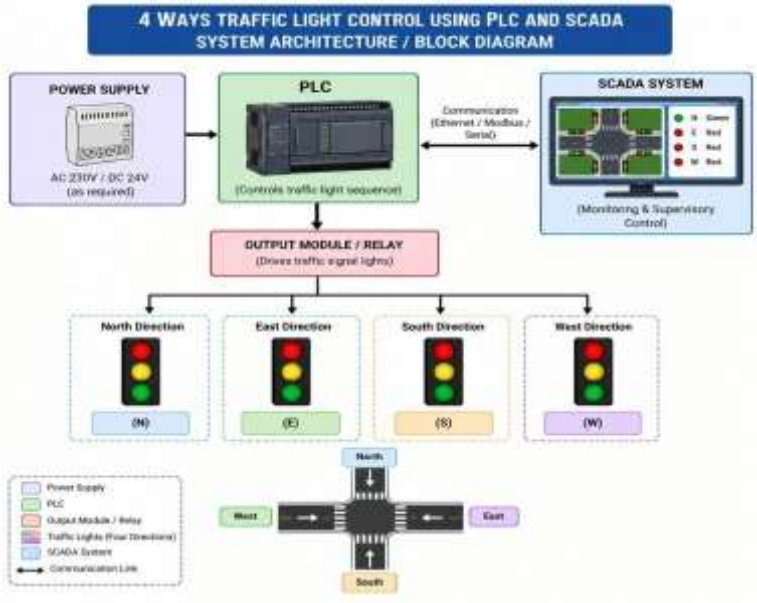
2.1 PROPOSED SYSTEM

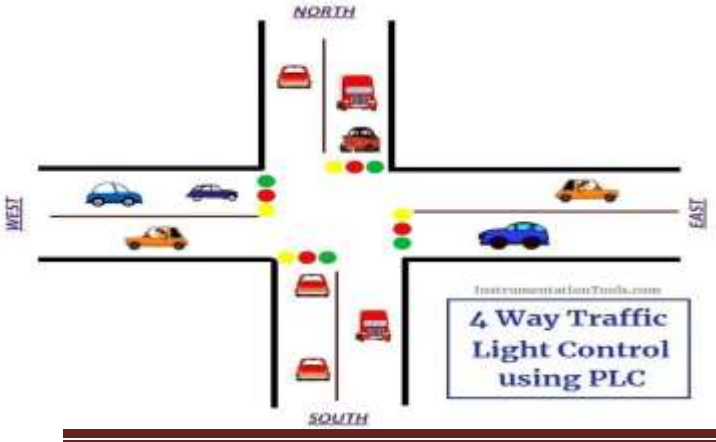
The proposed system is designed to control traffic signals at a four-way road intersection using a Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) system. The main objective of this project is to improve traffic management, reduce waiting time, and increase road safety through automatic and systematic control of traffic lights.

In this system, the PLC acts as the main controller. It is programmed to operate the red, yellow, and green lights for all four directions according to a predefined sequence and timing. The PLC ensures that only the permitted direction receives a green signal at a particular time, while the other directions remain red. The yellow signal is used to provide a transition period between green and red signals, helping vehicles stop safely before the next direction is allowed to move.

In conclusion, the proposed four-way traffic light control system using PLC and SCADA offers an automated, reliable, and user-friendly approach to traffic signal management. It combines the accurate control capabilities of PLC with the real-time monitoring features of SCADA to support safer and more efficient traffic movement at road intersections.

2.2 SYSTEM ARCHITECTURE / BLOCK DIAGRAM





SOFTWARE ARCHITECTURE

The software architecture of the four-way traffic light control system using PLC and SCADA is designed to control, monitor, and manage traffic signals at a four-way intersection. It consists of PLC programming software, SCADA software, a communication interface, and a graphical user interface (GUI).

The PLC and SCADA software architecture provides automatic traffic signal control and centralized monitoring for a four-way intersection. The PLC executes the programmed signal sequence using timers and interlocking logic, while SCADA displays signal status, supports timing supervision, and reports configured alarms. Their integration reduces manual intervention, simplifies system monitoring, and supports safe and organized traffic management.

3. HARDWARE-BASED SYSTEM

A..Programmable Logic Controller (PLC)



The PLC is the main control unit of the system. It executes the programmed logic and controls the red, yellow, and green traffic lights in all four directions. It uses timers and interlocking logic to maintain the required signal sequence.

B.Traffic Signal Lights



Red, yellow, and green LED indicators represent the traffic signals for North, South, East, and West. They display stop, caution, and go conditions according to the PLC program.

C Power Supply



The power supply provides the required voltage to the PLC and other control components. A regulated supply, such as 24 V DC, may be used when compatible with the selected hardware.

D.Computer with SCADA Software



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The computer runs SCADA software to display the status of each traffic signal, monitor the timing sequence, and supervise the operation of the PLC.

E.Communication Cable



An Ethernet cable connects a compatible PLC to the computer for data exchange between the PLC and SCADA software.

F.Connecting Wires and Driver Circuits



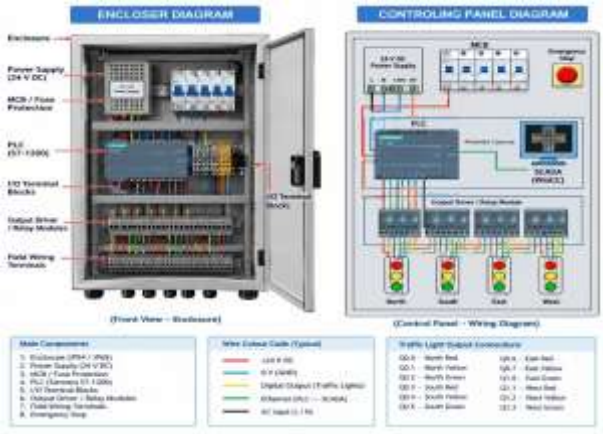
. These components connect the PLC outputs to the traffic lights. Driver circuits, interface relays, or transistor modules are used when the signal load exceeds the PLC output ratings.

F.Push Buttons and Protection Devices



Start and stop buttons can be used to operate the demonstration system. Fuses, suitable circuit protection, and emergency shutdown arrangements help protect the hardware

G.Enclosure and Control Panel



The diagram includes the electrical enclosure, 24 V DC power supply, MCB/fuse protection, Siemens S7-1200 PLC, I/O terminal blocks, output relay modules, SCADA (WinCC) computer, and traffic signals for all four directions.

4. WORKING OF THE SYSTEM

The four-way traffic light control system using PLC and SCADA works automatically to control traffic at an intersection in four directions: North, South, East, and West. The PLC acts as the main controller, while SCADA software is used to monitor the traffic signals and display their status on a computer screen.

1. System Initialization

When the power supply is switched ON, the PLC starts executing the programmed logic. It initializes the timers and sets the traffic lights to a predefined starting condition. The system checks the control sequence before beginning normal operation.

2. North–South Green Signal

The PLC switches ON the green lights for the North and South directions. At the same time, the red lights remain ON for the East and West directions. Vehicles in the North and South directions are allowed to move, while vehicles in the other two directions must stop.

3. Yellow Signal Operation

When the preset green-light timer expires, the PLC switches the North–South signals from green to yellow. This indicates that the green phase is ending and vehicles should prepare to stop according to traffic rules.

4. All-Red Interval

After the yellow phase, the PLC activates a short all-red interval. During this period, all four directions display red signals. This provides a clearance interval before traffic movement is permitted in the next direction.

5. East–West Green Signal

After the all-red interval, the PLC switches ON the green lights for the East and West directions. The North and South directions remain red. Vehicles in the East and West directions are permitted to move.

6. Second Yellow Signal and Cycle Repetition

When the East–West green timer expires, the PLC switches those signals to yellow, followed by another all-red interval. The controller then returns to the North–South green phase. This sequence repeats continuously until the system is stopped or a fault condition occurs.

7. SCADA Monitoring and Control

SCADA software communicates with the PLC through an Ethernet connection or another supported communication interface. It displays the current traffic-light status, timer values, operating mode, and configured alarms.

The operator can monitor the system and, if permitted by the program, change signal timings or select an operating mode. The PLC continues to execute the traffic-control sequence locally.

5. ENVIRONMENTAL & HEALTH CONSIDERATION

The four-way traffic light control system using a Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) can contribute to better traffic management, reduced fuel consumption, and improved road safety. The system controls traffic signals automatically and helps organize vehicle movement at road intersections.
Environmental and health considerations are important when designing and implementing this system.

Automatic traffic signal control helps organize vehicle movement and may reduce unnecessary idling at intersections. Reduced idling
. can lower fuel consumption and exhaust emissions, including carbon dioxide and other air pollutants. The actual reduction depends on traffic volume, signal timing, and road conditions

When traffic signals operate with suitable timing, vehicles may spend less time waiting unnecessarily at red lights. This can reduce fuel wastage and help improve traffic flow, particularly during busy periods.

The system can use energy-efficient LED traffic lights instead of conventional incandescent lamps. LEDs generally aste.

6. ADVANTAGES & LIMITATIONS

1. Advantages

1. Automatic Traffic Control: The PLC controls the red, yellow, and green signals automatically according to a predefined program, reducing the need for manual operation.
2. Improved Traffic Management: The system organizes vehicle movement in four directions—North, South, East, and West—at an intersection.
3. Accurate Timing: PLC timers provide consistent signal durations and help maintain a systematic traffic-control sequence.
4. Real-Time Monitoring: SCADA software displays the status of each traffic signal and allows operators to monitor system operation from a computer.
5. Reduced Human Error: Automatic control reduces errors associated with manual switching and helps maintain a consistent signal sequence.

2. Limitations

1. Initial Cost: Purchasing the PLC, SCADA-compatible hardware, power supply, signal LEDs, and communication equipment may increase the initial project cost.
2. Limited Traffic Adaptability: A basic system using fixed timers cannot automatically respond to changing traffic density unless sensors and adaptive-control logic are added.
3. Dependence on Electrical Power: A power failure can interrupt normal operation unless an appropriate backup power supply is provided.
4. Communication Failure: Loss of communication between the PLC and SCADA computer can interrupt monitoring and supervisory functions.
5. Programming Complexity: Developing reliable PLC logic and configuring SCADA communication requires technical knowledge and careful testing.

CONCLUSION

The four-way traffic light control system using Programmable Logic Controller (PLC) and Supervisory Control and Data Acquisition (SCADA) provides an efficient and reliable approach to automatic traffic signal management. In this system, the PLC controls the red, yellow, and green traffic lights for four directions according to a predefined timing sequence. The SCADA software allows the operator to monitor traffic signals, observe timer values, and supervise the overall operation through a computer.

In conclusion, the project demonstrates how PLC and SCADA technologies can be combined to develop an automated four-way traffic light control system. With suitable improvements and safety measures, this technology has the potential to support better traffic flow, improve road safety, and contribute to smarter traffic management in modern cities.

ACKNOWLEDGEMENT

First, we would like to thank our project guide for providing valuable guidance, continuous support, and encouragement throughout the development of this project. Their suggestions and technical knowledge helped us understand the concepts of PLC programming, SCADA monitoring, and automatic traffic signal control.

We would also like to thank our institute for giving us the opportunity to work on this project, which helped us improve our practical knowledge of industrial automation, hardware interfacing, and control systems.

This project has provided us with valuable practical experience in designing an automated traffic light control system using PLC and SCADA.

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