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# PLC Control Traffic Light System

Dr. Prabhat Kumar[1], Er. Umashankar Sharma[2], Ravi Kumar Sharma[3], Harsh Modi[4]
*Dept. of Electrical Engineering Arya College of Engineering & Information Technology, Jaipur, India*

***Abstract: A Programmable Logic Controller (PLC)-based Traffic Light System offers an efficient and automated solution for managing traffic at intersections.Traditional traffic light systems operate on fixed timers.Which often struggle to adapt to changing traffic conditions, resulting in congestion and delays. Implementing PLC technology enhances the reliability, flexibility, and responsiveness of traffic control systems. This system utilizes sensors, timers, and PLC programming to control traffic signals dynamically. The use of a PLC ensures high-speed processing, real-time control, and easy modification of traffic rules without requiring major hardware changes. Additionally, emergency vehicle prioritization and pedestrian-friendly crossing mechanisms can be integrated to improve safety and efficiency.***

## I. INTRODUCTION

An automatic traffic light system is an advanced signalling mechanism designed to regulate vehicular and pedestrian movement efficiently. Using sensors, timers, and artificial intelligence, it optimizesTraffic flow is optimized by dynamically adjusting signal timings based on real-time conditions, unlike traditional fixed-timer signals, these systems enhance road safety, reduce congestion, and minimize fuel consumption by decreasing idle time at intersections. They are widely implemented in smart cities, integrating technologies such as IoT and machine learning for improved performance. The automation of traffic control ensures smoother transportation, reduces human intervention, and contributes to sustainable urban mobility by improving efficiency and reducing emissions.

### *A. Design Of Hardware Circuit*

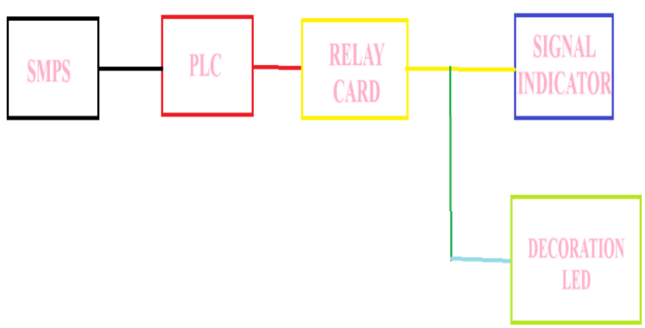


Figure: - Block Diagram of PLC

The diagram illustrates a basic electrical control system involving a Switched-Mode Power Supply (SMPS), Programmable Logic Controller (PLC), Relay Card, Signal
Cybersecurity threats pose risks to IoT-based traffic management. Poor pedestrian and cyclist integration creates safety concerns. Additional emergency vehicles often face delays due to rigid signal system. Environmental impacts, such as increased fuel consumption from idling, further highlight the need for adaptive traffic control solution.

### *B. Future Research Directions*

*1) AI-Powered Adaptive Traffic Signals*

Developing machine learning algorithms to optimize traffic light timing based on real-time traffic flow.

*2) IoT and Smart Traffic Management*

Integrating IoT sensors and cloud computing for real-time data collection and analysis.

*3) Vehicle-to-Everything (V2X) Communication:* -

Enabling traffic lights to communicate with vehicles for smoother traffic flow and reduced accidents.

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4) *Sustainable and Energy-Efficient Traffic Signals: -*
Exploring solar-powered and energy-efficient LED traffic lights to reduce environmental impact.
5) *Cybersecurity in Smart Traffic Systems: -*
Developing secure communication protocols to prevent cyber threats.

## II. PLC SIEMENS SIMATIC ET – 200S

Siemens SIMATIC ET 200S is a modular, decentralized I/O system designed for industrial automation. It offers flexibility, high performance, and compact design, making it ideal for machine control, process automation, and factory automation. The system supports PROFIBUS and PROFINET communication protocols, enabling seamless integration with central PLCs.One key feature of the ET 200S is its modular architecture, allowing users to add digital/analog I/O modules, motor starters, and safety modules as per requirements. Some models come with an integrated CPU, making them capable of independent operation. The system ensures fast signal processing, high availability, and energy efficiency, making it suitable for demanding industrial environments.It is widely used in manufacturing plants, conveyor systems, and smart factories, ensuring optimized automation and improved operational efficiency.The Siemens ET 200S supports modular digital and analog inputs/outputs, enabling flexible automation. It includes DI/DO modules for discrete signals and AI/AO modules.


Figure: - Siemens ET 200S

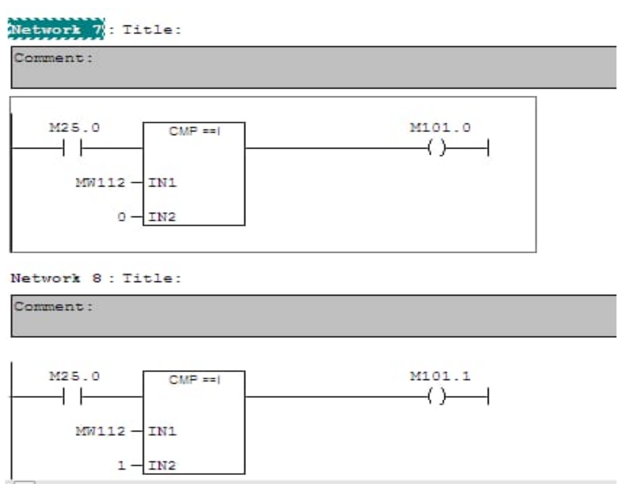


Figure: - Program of PLC

 

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Switching Timing: -

| Signal Indicator | Time ($T_c$) |
|---|---|
| Yellow ($T_Y$) | 10 Sec |
| Green ($T_G$) | 13 Sec |
| Red($T_R$) | 52 Sec |

$$Tcycle = Ty + Tg + Tr$$

Duty cycle: -

$$P_{Y/G/R} = T_{Y/G/R} / T_c$$

Delay per vehicle: -

$$Davg = T_R + T_Y / 2$$

## III. LITERATURE REVIEW

Real-Time Traffic light Remote Monitoring System: - A Real-Time Traffic Light Remote Monitoring System is a smart traffic management solution that enables remote monitoring and control of traffic signals using IoT, cloud computing, and wireless communication. It integrates traffic controllers, sensors, and cameras to track real-time signal status, detect malfunctions, and optimize traffic flow. Data is transmitted to a central dashboard, allowing authorities to monitor performance, receive alerts, and make adjustments remotely. This system enhances traffic efficiency, reduces congestion, lowers maintenance costs, and improves road safety. It is widely used in smart cities to enable adaptive traffic control and emergency response coordination.

### *A. Traffic Light Monitoring System:*

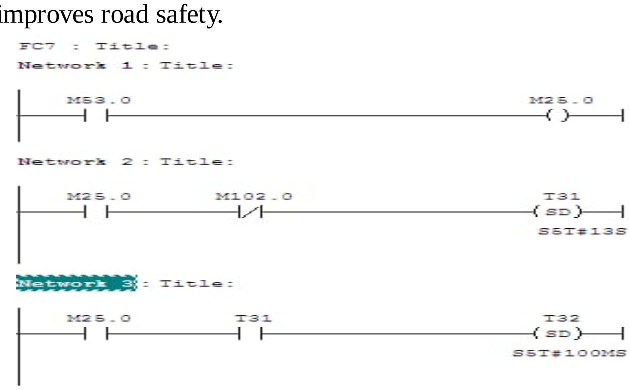
Traffic Light Monitoring System is a smart solution that enables real-time supervision and management of traffic signals. It integrates traffic controllers, sensors, and communication networks to monitor signal performance, detect faults, and optimize traffic flow. Using IoT and cloud-based technology, the system collects data on light status, traffic density, and power failures, transmitting it to a central control unit for analysis. Authorities can remotely adjust signals, receive alerts, and ensure smooth traffic movement. This system enhances road safety, reduces congestion, lowers maintenance costs, and supports smart city initiatives by enabling efficient and data-driven traffic management.

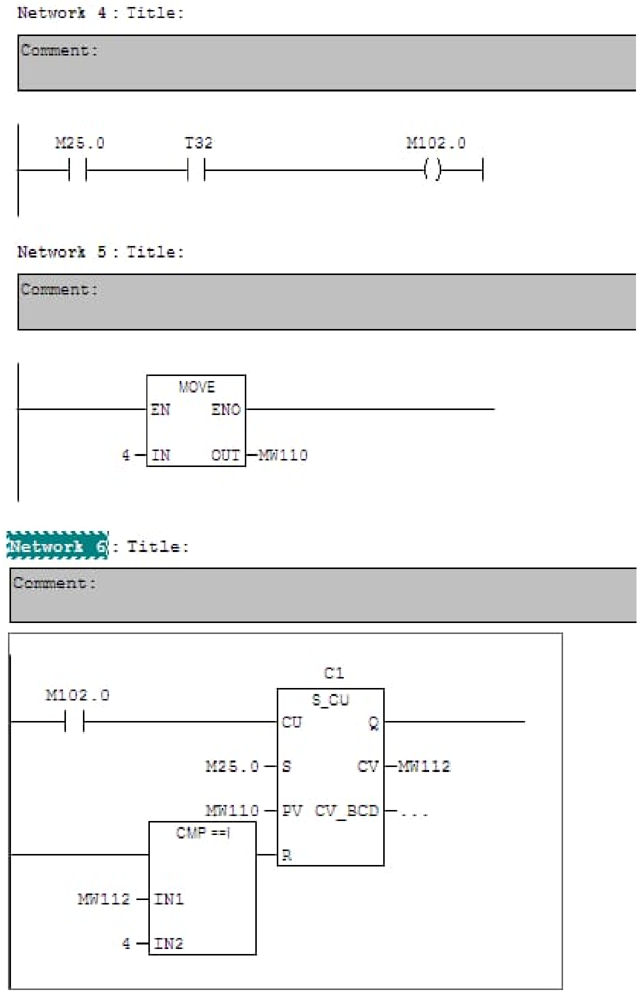
### *B. Challenges and Limitations: -*

Traffic lights face several challenges and limitations that affect their efficiency. Fixed-time signalsnot adapt to real-time traffic conditions, leading to congestion and delays. Power failures and technical malfunctions can disrupt operations, increasing accident risks. High installation andmaintenance costs make upgrading to smart systemscostly.

## IV. DESIGN OF MONITOR SYSTEM

The design of a traffic light monitoring system involves Timer, Counter, Comparator, and a communication network to ensure real-time supervision of traffic signals. The system consists of traffic controllers that regulate signal timing, and counter start to count plus of traffic signals if pre define value is equal to post value than one traffic signal will be stop and second traffic signal will be start. Additionally, an alert system notifies officials of power failures or malfunctions. This smart monitoring system enhances traffic efficiency, reduces congestion, and improves road safety.






A key advantage of this system is its ability to give priority to emergency vehicles, improving response times for ambulances, fire trucks, and police vehicles. Furthermore, V2X (Vehicle-to-Everything) communication can beintegrated to allow traffic signals to interact with connected vehicles, improving safety and efficiency.

However, challenges remain, including high implementation costs, cybersecurity threats, and system failures due to environmental conditions. Future research should focus on AI-powered adaptive traffic signals, renewable energy sources for traffic lights, and improved security protocols to prevent cyber threats.

In conclusion, the Traffic Light Monitoring System is a crucial innovation for smart cities, enabling real-time monitoring, efficient traffic control, and enhanced road safety. By leveraging advanced technologies such as AI, IoT, and cloud computing, future traffic management can become more adaptive, responsive, and sustainable.

## V. CONCLUSION

The Traffic Light Monitoring System is a crucial component of modern intelligent transportation systems enhance road safety, reduce congestion, and improve traffic flow efficiency. The image depicts a traffic control system at a four-way intersection, featuring traffic signals with green, yellow, and red indicators, along with a monitoring interface featuring ON/OFF controls. Such systems play a vital role in automating and optimizing urban traffic management.By integrating IoT-based sensors, real-time monitoring, and adaptive signal control, these systems enhance decision-making for authorities. The real-time monitoring allows early detection of failures, such as power outages, signal malfunctions, or traffic irregularities, ensuring quick corrective actions. Additionally, smart traffic management reduces vehicle idling time, leading to lower fuel consumption and decreased carbon emissions, supporting sustainable urban mobility.

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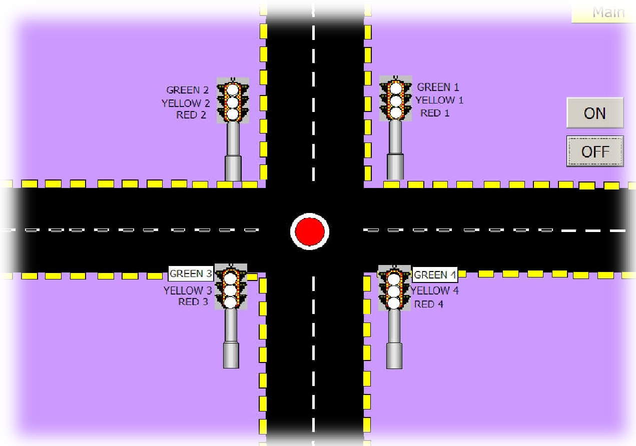


Figure: - SCADA creates safety concerns. Additionally, emergency vehicles often face delays due to rigid signal systems. Environmental impacts, such as increased fuel consumption from idling, further highlight the need for adaptive traffic control solution.

Indicator, and Decoration LED. The SMPS supplies power to the PLC, which controls the Relay Card. The Relay Card acts as an interface to switch different loads. One output of the relay activates the Signal Indicator, while another output powers the Decoration LED. This setup is commonly used in automation and control systems to regulate and signal.different operations efficiently. The color-coded connections represent various signal paths and power distributions in the system.

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