Smart Traffic Control System Using PLC And Scada

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Abstract- *Smart traffic control system is a modern engineering technology, which is intended to measure traffic density by counting the number of vehicles in each lane. In this system PLC takes a data from sensors and checks the priorities. The mechatronic system which is provided for troubleshoot the problems occurring during heavy traffic. To calculate the vehicle densities in a lane at a 4-way lane cross and then give the priority automatically using a program. The lights [green, yellow, red] ON & OFF time is depend on the specific priorities which can be decided by logic program.*

Keywords- Smart Traffic Control System, PLC, SCADA, etc

I. INTRODUCTION

Traffic light which is one of the vital public facilities plays an important role to the road users. Traffic signal light is used to control the movement of vehicles and passengers, so that traffic can flow smoothly and safely. Traffic signal lights are relatively simple and common in places, 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 accidents and the most recently to their utility in controlling the flow of traffic through metropolitan areas which have been used together with computer systems. In the conventional traffic control system it may be observed that the time of signal light glowing for a particular road will be always constant. Sometimes it may happen that, one particular road may be crowded more than any other. In such cases, the conventional traffic control system will fails to give priority to the heavy traffic lanes.

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A. Programmable Logic Controller

A PLC (Programmable Logic Controller) is a device that was invented to replace the necessary sequential relay circuits for machine control. The PLC works by looking at its inputs and depending upon their states turning on/off its outputs. The user enters a program via software that gives the desired results. PLC or a programmable logic controller is used to check and control a system using digital inputs which can be programmed for automation. The growth of PLC started in 1970s. The PLCs have become a major component of factory mainly because of the advantages they offer like.

1. Cost effective control for complete system
2. Flexible and reusable
3. Computational abilities
4. Analytical power and decision making

B. SCADA

SCADA is an acronym for Supervisory Control and Data Acquisition. SCADA generally refers to an industrial computer system that monitors and controls a process. In the case of the transmission and distribution elements of electrical utilities, SCADA will monitor substations, transformers and other electrical assets.

Supervisory control and data acquisition (SCADA) is a system of software and hardware elements that allows industrial organizations to:

1. Control industrial processes locally or at remote locations
2. Monitor, gather, and process real-time data
3. Directly interact with devices such as sensors, valves, pumps, motors, and more through human-machine interface (HMI) software
4. Record events into a log file

SCADA systems are crucial for industrial organizations since they help to maintain efficiency, process data for smarter decisions, and communicate system issues to help mitigate downtime.

The basic SCADA architecture begins with programmable logic controllers (PLCs) or remote terminal units (RTUs). PLCs and RTUs are microcomputers that communicate with an array of objects such as factory machines, HMIs, sensors, and end devices, and then route the

information from those objects to computers with SCADA software. The SCADA software processes, distributes, and displays the data, helping operators and other employees analyze the data and make important decisions

II. METHODOLOGY

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 vehicles based on their weight, like buses, trucks etc. in one lane, cars in one lane and like this the traffic congestion can be solved by diverging the traffic accordingly. 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.

A. PLC Architecture

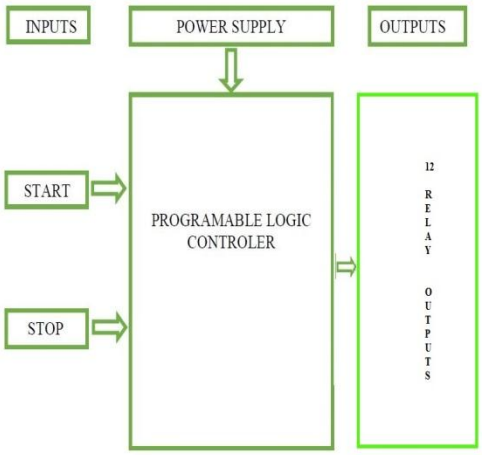


Fig. 1 Working of PLC

The traffic will be adjusted across the junction with the help of programming done in the PLC as showing in figure 1. The programming is done in such a way that the traffic signal lights will be functioning automatically based on the prescribed time in the Timer Instruction which is the special instruction used for creating the delay. The lights will be turning ON and OFF automatically according to the time given in the timer instruction. With the help of PLC, the traffic management in urban cities will become easy and hassle free.

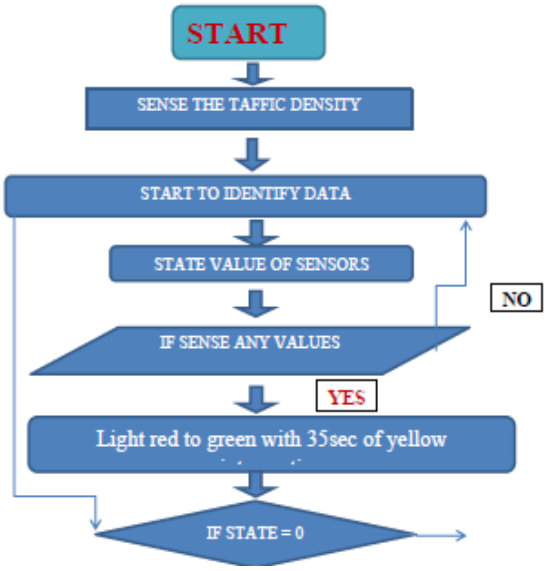


Fig. 2 Flow Chart Traffic Light Control System

The figure 2 shows the wiring connections for the MCB, SMPS, PLC unit & Relays. The relays are set in parallel according to the program instruction fed by the PLC the lights (red, yellow, green) are glows by the set of relays which acts as a switches when the vehicle arrives in the lane.

III. HARDWARE IMPLEMENTATION

A. Delta PLC

The operation of a PLC is very simple. The processor makes decisions based on a "ladder logic" program written by the user. In order to use the program properly, the PLC must communicate with the various field devices it monitors and controls. It then compares the actual conditions of the field devices with what the program instructs them to do, and updates the output devices accordingly. It has 8 inputs and 6 outputs

Fig. 3 Delta Output Module

The figure 3 represents the programmable logic controller, PLC or programmable controller is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or light fixtures. PLCs are used in many industries and machines. PLCs are designed for multiple analogue and digital inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operation are typically stored in battery backed-up or non-volatile memory. A PLC is an example of a "hard" real-time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

B. Power Supply (SMPS)

The function of the power supply is to provide the DC power to operate the PLC. It is supplied by single-phase 120 or 240 VAC line power that powers the PLC system. The Power Supply is a module located in the PLC system module rack. The DC power (voltage and current) it provides power the other modules in the rack, such as the CPU, Co-processor Modules, and I/O Modules. The line power provided to the PLC system also powers the I/O Field Devices. The PLC system is protected against PLC module or field device malfunctions.

Fig. 4 switched mode power supply

A switched-mode power supply is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently is showing in figure 6. Like other power supplies, an SMPS transfers power from a DC or AC source to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. Ideally, a switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to off time. In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight. Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weights are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.

C. Output Module

Output modules convert control signals from the CPU into digital or analog values that can be used to control various output devices. The programming device is used to enter or change the PLCs program or to monitor or change stored values. Once entered, the program and associated variables are stored in the CPU. In addition to these basic elements, a PLC system may also incorporate an operator interface device to simplify monitoring of the machine or process.

D. Relay

A relay is an electromagnetic switch operated by a relatively small electric current that can turn on or off a much larger electric current. The heart of a relay is an electromagnet, a coil of wire that becomes a temporary magnet when electricity flows through it. Relay is a kind of electric lever switch it on with a tiny current and it switches on another appliance using a much bigger current. As the name suggests, many sensors are incredibly sensitive pieces of electronic equipment and produce only small electric currents. But often we need them to drive bigger pieces of apparatus that use bigger currents as shown in figure 5.

Fig. 5 Electromechanical Relay

Relays bridge the gap, making it possible for small currents to activate larger ones. That means relays can work either as switches, turning things on and off or as amplifiers, converting small currents into larger ones.

E. Indicators

One of the most common indicators used in measurement and status report are traffic light indicators as shown in figure 8. Traffic light indicators are most commonly shown as a set of red, yellow and green lights. The power specification of indicator is 24V 0.5A.The world's first traffic light was short lived. It was a manually operated gas-lit signal installed in London in December 1868. It exploded less than a month after it was implemented, injuring its policeman operator. Traffic control started to seem necessary in the late 1890s and Earnest Sirrine from Chicago patented the first automated traffic control system in 1910. It used the words "STOP" and "PROCEED", although neither word lit up

.

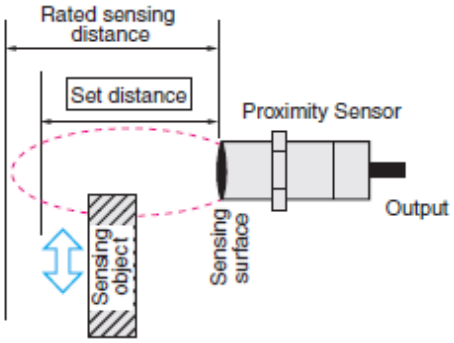
Fig. 6 RYG Indicators

- The green light allows traffic to proceed in the direction denoted, if it is safe to do so and there is room on the other side of the intersection.
- The yellow light warns that the signal is about to change to red.
- The red signal prohibits any traffic from proceeding. A flashing red indication is treated as a stop sign.

F. Proximity Sensor

A proximity sensor is a sensor able to detect the presence of nearby objects without any physical contact is shown in figure 7.

A proximity sensor often emits an electromagnetic field or a beam of electromagnetic radiation and looks for changes in the field or return signal. The object being sensed is often referred to as the proximity sensor's target. Different proximity sensor targets demand different sensors. An inductive proximity sensor always requires a metal target. Hence it is more often used for vehicle detection in traffic control system.



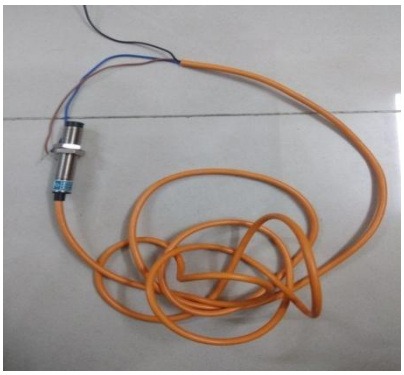


Fig. 7 Working of 3 Wire Proximity Sensor

G. Push Button

The figure 8 represents the push-button or simply button is a simple switch mechanism for controlling some aspect of a machine or a process. Buttons are typically made out of hard material, usually plastic or metal. The surface is usually flat or shaped to accommodate the human finger or hand, so as to be easily depressed or pushed. Buttons are most often biased switches, although many un-biased buttons still require a spring to return to their un-pushed state. Terms for the "pushing" of a button include pressing, depressing, mashing, hitting,and punching.
In industrial and commercial applications, push buttons can be

connected together by a mechanical linkage so that the act of pushing one button causes the other button to be released

.

Fig. 8 Push button

H. Terminal Block

A terminal block is a screw-type electrical connector where the wires are clamped down to the metal part by a screw. It is a connector which allows more than one circuit to connect to another circuit is shown in figure 9. It often contains two long aluminum or copper strips that are designed to connect different components. These strips create a bus bar for power distribution that is sent to the connected components. A barrier strip is composed of several screw terminals.

There are many applications that use terminal blocks & barrier strips. Screw-type terminals are often used in order to connect a chassis ground, like on a surge protector. Several public address systems use them for speakers and other inputs and outputs. Screw terminals are very widely used in electricity wiring, to connect switches, and for connecting major appliances to plugs at home.

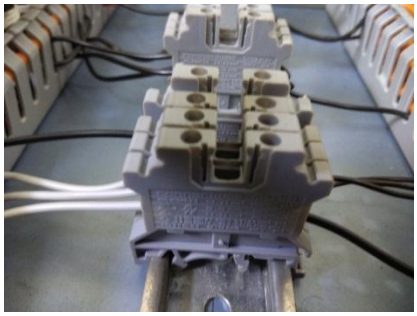


Fig. 9 Terminal Blocks

I. Truss

In engineering, a truss is a structure that "consists of two-force members only, where the members are organized so that the assemblage as a whole behaves as a single object". A planar truss lies in a single plane. Planar trusses are typically used in parallel to form roofs and bridges are as shown in figure 10.

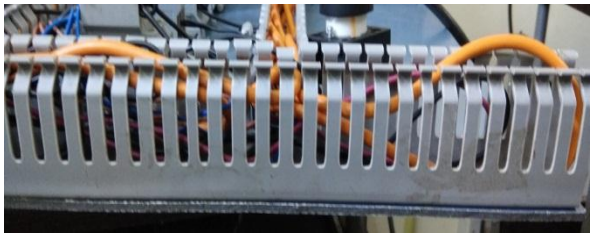


Fig. 10 Planer Truss

The depth of a truss, or the height between the upper and lower chords, is what makes it an efficient structural form.

IV. SOFTWARE IMPLEMENTATION

A. Delta

Delta group of companies is headquartered in TAIWAN Delta Group is the world's largest provider of switching power supplies and DC brushless fans, as well as a major source for power management solutions, components, display solutions, industrial automation, networking products, and renewable energy solutions. Delta Group has sales offices worldwide and manufacturing plants in Taiwan, China, Thailand, Mexico, India and Europe. For more than 40 years, Delta Group has pursued the mission. "To provide innovative, clean and energy-efficient solutions for a better tomorrow." With its focus on continuous innovation, Delta has become a global leader in a range of products and has received the Forbes Asia "Fabulous 50" Award for several consecutive years.

B. Programming in PLC

Every PLC has associated programming software that allows the user to enter a program into the PLC. Before a PLC can perform any control task, it must be programmed to do so. The controller offers programming languages such as:

- Ladder Language (LD)
- Function Block Diagram (FBD)
- Sequential Flow Chart (SFC)
- Structured Text (Higher level languages such as C)

The common program language of PLC is ladder diagram is used here.

C. Ladder Language

The Ladder logic is widely used in programming PLC where sequential control of a process or manufacturing

operation is required. It is a graphic Language and can be used to transcribe relay diagrams, and is suited to combinational processing. It provides basic graphic symbols, contacts, coils, and blocks. Specific calculations can be executed within the operation blocks. Any control task modifications are done by changing the program.

D. Simple Ladder Diagram of a Hardwired Circuit

The language itself is a set of connections between logical checkers (contacts)and actuators (coils). If a path traced between the left side of the rung and the output, through asserted (true or closed) contacts, the rung is true and the output coil storage bit is asserted. If no path is traced, then the output is false (0) and the coil by analogy to electromechanical relays is considered de-energized. The symbols used in the PLC program are explained below.

- | | - Normally open
- |/| - Normally closed
- **( )** - Load
- **TMR** - Timer
- **T0** - Number of the timer
- **K0** - Number of seconds.
- **CNT**- Counters
- **DN**- Resistors
- **X**- Sensors

E. InTouch

InTouch goes beyond simplistic graphics to enable application builders to focus on creating meaningful content that will drive enterprise-wide operations productivity and cost savings. InTouch empowers operators to optimize their routine human interactions with industrial automation systems. This results in a quantifiable net increase in operator effectiveness. Our unique approach through situational awareness libraries provides contextualized information that operator need to quickly and accurately address abnormal situations before they impact operations.

Used in more than one-third of the world's industrial facilities, in virtually every country and industry, InTouch HMI software continues to deliver business value in engineering simplicity, operational agility and real-time performance mastery. It is under the control of Schneider Electric.

V. RESULTS

The conventional traffic light system uses microcontroller which are troublesome in daily usage. And the microcontrollers need regular maintenance so that the future investment cost increases. So here the smart traffic light control is a sustainable way to replay the microcontrollers and also they are easy to adapt and sustain temperature conditions. Here in this project we are using traffic density control so that we will monitor the traffic density and control the delay of the traffic signals automatically. Inductive Proximity sensors are implemented to find out the traffic density.

- The concepts of PLC programing has been studied and implemented successfully
- The Ladder has been done based on the logic required and tested successfully
- The whole project objective is to calculate the density of the traffic and the time of the traffic light should be adjusted accordingly which has been done full fledge
- The importance of SCADA has been studied and has been used in an efficient way to control and monitor the whole process of traffic light control
- The concept of relays was understood and used for controlling the traffic lights
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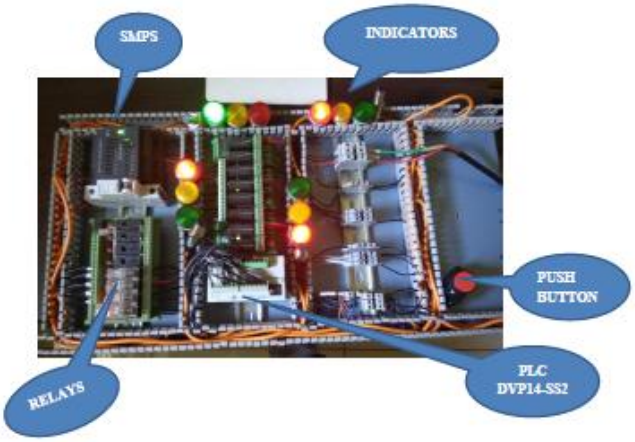

Fig. 11 Working Model of a Smart Traffic Control System

VI. CONCLUSION

The designed and implementation of this technique is directly targeted for traffic management so that emergency vehicle on road get clear way to reach their destination in less time and without any human interruption. The main scope of these smart systems is to have the traffic lights mimic the human intelligence thus eliminating the need of having traffic officers control traffic on the roads. These intelligent systems

provide a way for the lights to change from red to green based on current traffic conditions. The sensors are interfaced with Delta PLC Module. This interface is synchronized with the whole process of the traffic system. The method will help to reduce congestion on roads and would help in coping traffic at junctions and accidents.

VII. FUTURE SCOPE

- Sensors like Pressure and load sensors can be integrated with the PLC which can be used to measure the traffic density in the real time.
- Instead of Proximity sensors Machine Vision Systems can be implemented to get accurate density of traffic.
- The main advantage of PLC is we can add nearly 31 Slave devices in this particular communication medium which can be used to automate a whole city traffic
- Wireless SCADA can be implemented

REFERENCES

[1] Azura Che Soh/Lai Guan Rhung "MATLAB Simulation of Fuzzy Traffic Controller for Multilane Isolated Intersection" 02-04-11.

[2] Barz C, Oprea C, Erdei Z, Pop-Vadean A and Petrovan F 2014 *The control of an industrial process with PLC*, International Conference on Applied and Theoretical Electricity (ICATE) Craiova, Romania, pp. 1-4 October 23-25.

[3] Xu Li, Wei Shu, Minglu Li, Hong-Yu Huang, Pei-En Luo, and Min-You Wu, "Performance Evaluation of Vehicle-Based Mobile Sensor Networks for Traffic Monitoring" IEEE 2009.

[4] Downs, A. (1962). "The law of peak hour expressway congestion". *Traffic Quarterly* pp.393–409.

[5] "PLC Based Intelligent Traffic Control System", Muhammad Arshad KhattakInternational Journal of Electrical & Computer Sciences.

[6] Rajeshwari Sundar, Santhoshs Hebbar, and Varaprasad Golla "Implementing Intelligent Traffic Control System" Sensor Journal, IEEE (Volume: 15).