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Advanced Traffic Signal Monitoring using Programmable Logic Controller (PLC)

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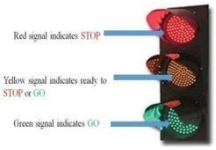
***Abstract*- The purpose of the project is to execute the traffic signal monitoring system based on PLC technology. In our project, a system designed for monitoring the four-sided roundabout. In our project, there are four major monitoring features, one being that in the case of a normal cycle of vehicles having the same density on all roads forming a junction. Next, when there is presence of physically challenged pedestrians, a pedestrian signal is applied to pass the pedestrian safely. Next, if the vehicle's density is more on any lane, the green signal will illuminate for more time with respect to vehicle's traffic. The final feature is priority/emergency. In the priority feature, the green signal illuminate for the priority lane and the other shows red signal until emergency is over. After that normal cycle repeats. There is a ladder diagram developed for its implementation in PLC. As the traffic police find it difficult to control the entire traffic from day to night. So, this project can be applied on NH, city roads and intersections, such as 4 ways, 6 lanes etc.**

Key words- Traffic Control, PLC- Programmable Logic Controller, Allen-Bradley, MicroLogix, PDS- Pedestrian, N- Normal, PRI-Priority, TINC- Time Increase, PCT- Pre-set cycle time, NH-National Highway

1. INTRODUCTION

Traffic Signal is one of the crucial facilities for road users. Traffic lights are applied to govern the ruse of vehicles and pedestrians, so that road users can move easily and securely. The prior traffic light is not automated and the time for which it glows is specific due to which some time the traffic congestion and road mishappening may occur due to a pedestrian or rush on a specific road. Hence, we introduce PLC controlled advanced traffic light system.

An advance traffic signal comprises of various sensors implanted on the road which collect the real-time data, and these traffic lights give output based on the data collected. Our process and control of the traffic light can be done by many automated tools, but in our case we are using PLC. [1]



Traffic Light Model

2. LITERATURE REVIEW

In n this project, the vehicle count on each lane are referred as traffic congestion, then apart the traffic accordingly. It is also not simple for policemen to govern the whole scenario in such a small time. [2] [3] The problem in the traffic has enhanced in the previous few years, now-a-days traffic lights have restriction because they use pre-determined hardware that doesn't have scope of variation on a real time basis. Waiting time is more due to the specific time interval of LED's. [4]

Various sensors are deployed on road that signals are taken in count by the traffic monitoring system. The evolving global system ensures coordination of four squares, establishing a path that respects the coordination mode of light; integrate additional sensors to inform traffic participants about the recommended speed to reach the green state in crossroads. [5]

To detect the daily traffic system video cameras are applied. This data is then collectively used to manage traffic. The image scan and the support memory are two main parts of system input, Further the image scan have two main phases i.e. training and detection phase. The images captured from image scanner are then converted into binary form using filter. The training phase will further use these images in case of road mishappening, later these images are saved to memory for further investigation and recognition. [6]

He considered emergency cases in the design where, if an emergency occurs, priority vehicles will run first, using MCGS to animate and simulate the system. The paper does not show what sensors are used or how the software is programmed to detect emergency cases, but in conclusion, they mentioned that the system is okay. [7]

To calculate the green LED's time, the project has a mathematical tool and a plc controller for controlling traffic monitoring unit. For detecting the presence of vehicles, PE sensors are used, but inductive loop sensors are suggested for the real-time system. For the simulation of PLC, TRILOGI software is taken in use. [8] [9]

3. PROPOSED SYSTEM

3.1 Problem Formulation

In many countries, the city's traffic lights are becoming a major problem. The increasing number of vehicles and lower phases of development of highways have led to the problems of traffic congestion, particularly in major cities. Moreover, delays due to traffic congestion are also indirectly affecting productivity, efficiency and energy loss. There are a number of factors that cause traffic congestion, such as the density of vehicles on roads, human habits, social behaviour and traffic lighting systems. With effective control over intersections, it is believed that the overall capacity and performance of the urban traffic network can be resolved. There are various standard methods of traffic light control. However, the prior traffic lights are inadequate to deal with time-changing and more traffic efficiently. The PCT is the most common method which is used now-a-days in many sites of world. Many traffic police men are deployed in the city during busy time. From this scenario it is clear the traffic lights which are being used are not working properly and efficiently, i.e.,

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they are inadequate. Hence it takes high time for the replacement of these traffic light by more efficient, newer, more automated and viable traffic monitoring system. This project aims towards the development of more automated and advanced traffic monitoring system controlled by plc. Three main problems can be resolved by our project.

1. If the waiting area of the pedestrian is empty, the traffic monitoring system will not glow the pedestrian LED and hence no hindrance in a normal cycle.
2. Secondly in case of priority or emergency vehicles, we have customized our traffic monitoring system in such a way that our sensor will detect the emergency vehicle and the lane in which there is a presence of such vehicle gives a green LED by traffic and that lane is glowed until the vehicles pass. 3. The traffic rush on any side is referred to as traffic density in our project. In such cases the time of the green light is increased for the lane in which there is traffic density.

These three main features of our traffic light monitoring system are making our system better than traditional traffic light. Hence, this will reduce the traffic congestion and also ensure the safety of road users.

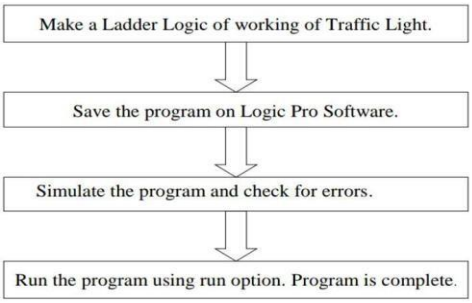
3.2 Objective

- Make a system of a traffic light which will play a normal cycle.
- Consider a pedestrian cycle in a system.
- Consider emergency or priority cases to give a green signal immediately.
- Make a system to increase Green light time of a lane having high density of vehicles.

4. METHODOLOGY

It is a graphical artificial language. Ladder logic programming has been swollen to include tasks such as counter, timers and maths operations. The observation that the program in this language is sort of a ladder with a series of vertical “rails” and horizontal “rugs” between them. PLC is operated by continuously scanning the program and working on instructions at a time to turn various outputs on or off. To do this, the PLC scans all the input first and store them States in memory. It then scans the program and decides which output should be high according to the program logic. In this section the data collected from the sensor deployed on the roads can be used, but we are not using that real time data and the data which we are taking in use is prepared by us. This data will be further processed using plc. The reason behind that we are not using the real time data in our project is that we don’t deploy it on the road.

4.1 FLOW CHART



4.2 WORKING

The data collected from the sensor are in integer form. An inductive loop sensor is used to collect the data in integer form. Furthermore, this data is converted into a Boolean by the RFID sensor. [10] As our project is working on a roundabout, thus both the sensor that is RFID and an Inductive loop sensor collect from each direction. The output of the sensor will be the inputs of Plc, and such inputs will be used by the specific program to obtain the desired output. But in our case, there is no live action on the road; we will do it in the lab. So we don't use any sensor. We directly give the authority to the police man who will do according to him. If the number of vehicles is increased on one side, he will increase the time of the timer. In an emergency case or priority case, a police man directly pressed the start push button on the priority side, gave a green signal and all other signals would remain red until he pressed the stop push button. In case of a pedestrian cycle, this will be allowed only when a police man sees a man who doesn't cross the road, especially for handicapped, senior citizens. When he sees he will press the pedestrian start push button. The pedestrian signal will start only when the main signal green light is over.

5. HARDWARE

5.1 Programmable Logic Controller (PLC)

PLC used is Allen-Bradley.PLC works on twentyfour volts direct current, and the sensor also required input and output of similar voltages. The PLC comprises both digital input/output and Analog input/output. Digital inputs is 10, Digital output is 10, Analog input is 2 Analog output is 2 But the requirement is 15 inputs and 20 outputs. To meet the requirement of the desired input/output SM 1223 Signal module is added to our project which grants 3 more digital inputs and eight more Digital outputs. **5.2 LED (Red, Yellow, Green)**

LED used are Red, Green and Yellow represent the exciters. These are the basic LED, 5 mm in size, work on 2- volt DC and 20 mA. It cannot be connected directly to the PLC as the output is 24VDC. In the actual case, the traffic light is floating on 240 AC Volt But in the prototype case, it is of 2 volt. So can be connected directly. The use of a converter or resistors is mandatory.

5.3 Resistor (2.2kΩ)

Since the PLC output voltage is 24-volt and the LEDs operate on 2-volt if they are connected in series, the voltage across the resistor will be 24-

2=22-volt. From the basic Ohm’s law.

6. SOFTWARE

6.1 Allen-Bradley MicroLogix The Allen - Bradley MicroLogix 1100 family of programmable logic controllers (PLC) is also known as small logic controller, especially complete micro and small - level automation applications. With data logging and relatively large allocated memory for resident storage as compared to MicroLogix 1500, MicroLogix 1100 product line is excellent for remote monitoring and used for applications that require large and intensive memory

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access, but with less I/O density. The controller is a compact controller with ten digital input, two analog input each model embedded with digital output, while dc input has an additional feature of an embedded 40khz high speed counter and DC output controllers are provided with two 40khz high speed pulse train output/pulse width modulation output. All MicroLogix 1100 are configured using RSLogix 500 Programming Software, a ladder language enabled software that is Microsoft Windows based.

7. SIMULATION

Our PLC controlled traffic monitoring system monitors the four-way roundabout along with a pedestrian signal. There are fifteen inputs and twenty outputs in our project. There are eight RED, eight GREEN and four yellow LED's which comprises the output of the system. The roundabout has RED, GREEN and YELLOW LED's on each side. But there are only RED and GREEN LED's for each pedestrian side. The LED's are deployed symmetrical on the roundabout and pedestrian lane, which means that every signal will operate on its own time. But in case of a pedestrian signal, when the signal glows green, all the other vehicles signal will turn red. In our project/system there are four cycle which are explained below:-

1. **Normal Cycle: -** The normal cycle means that when we start our system, the GREEN light of lane 1 will start for thirty seconds and the other lane glows RED signal. After that, the transition of signal begins. For transition lane 1 and lane 2 glows yellow signal for ten seconds and the remaining lane glows red signal. After ten seconds, the green signal glows in lane 2 for thirty seconds and the other lane shows a RED signal. After that, the same sequence of transition occurs for lane 3 and lane 4. After completed the cycle, the transition occurs between lane 4 and lane 1 and again restart the system from lane 1 and cycle moves on until we stop the system.
2. **Pedestrian Cycle: -** In this cycle when there is any pedestrian in a waiting area of a pedestrian, they will pass a request for green light, but the request is only accepted when the green light of the normal cycle is off. When the the green light of the normal cycle is off, the cycle moves from a normal cycle to a pedestrian cycle for 10 seconds, and after ten seconds they will move back to a normal cycle. This means during the ten-second period only pedestrian signal glows green and the other one shows red signal.
3. **Priority Cycle: -** This cycle can disrupt or stop all other cycles. This will come into action only when we have an emergency. When we pressed the start priority push button of the lane 1, 2, 3 or 4 and gave a priority or green signal for that direction, until we pressed the stop priority push button of that lane. When we pressed the priority stop push button, the normal cycle began again.
4. **High Density Cycle: -** In this case, we don't have real-time data of the number of vehicles. If we got that data, we set a limit of high density and using compare function we will trigger the time of the timer, but we don't have real time data. So, for that we gave push buttons to increase the time of the timer of the green light, i.e., it will move from 30 to 45 seconds when we press the high density push button.

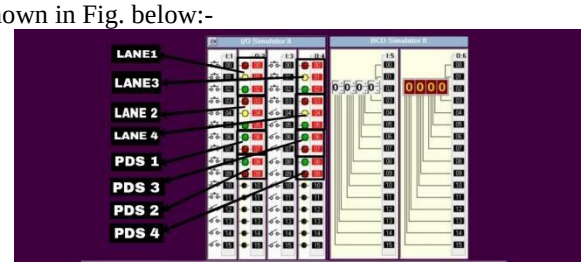
7.1 Implementation

There are several ways to do our program of advance traffic signal monitoring system, i.e., ladder logic method, sequential output method etc. We used the ladder logic method in our system. In our program we use input push buttons, output, binary, MOV and timer. A timer is used to glow the set of sequence accordingly in time. The program is reset using the end timer to continue running. MOV is used to extend the timer time. Binary is used for latching. Program done in the RSLogix 1000 software. Therefore, we are dividing our program into four parts/cycles.

8. RESULT

Design and Construction of prototype of advanced traffic light control system for the intersection for all round traffic lights has been developed with automatic ON and OFF operation of traffic lights. The model test was performed on simulator and the result we have received is shown below in order:-

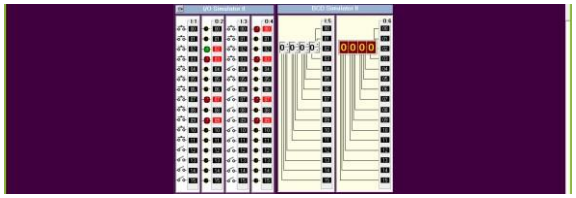
The Outputs of the Advanced Traffic Light/Lane are look like as shown in Fig. below:-



The sequences of light blinking in output are shown below:-

1. Normal Cycle:-

The output of the normal cycle is shown below. In a normal cycle, first Lane1 shows green light when we start the system and all the other shows red light. After 30 seconds, lane1 and lane2 show yellow light for 10 seconds, and after that, lane2 shows green LED and all the other shows red LED, and the further sequence operates as lane1 and lane2.



Lane 1- Green Signal	Lane 2- Red Signal
Lane 3- Red Signal	Lane 4- Red Signal
PDS-1- Red Signal	PDS-2- Red Signal
PDS-3- Red Signal	PDS-4- Red Signal

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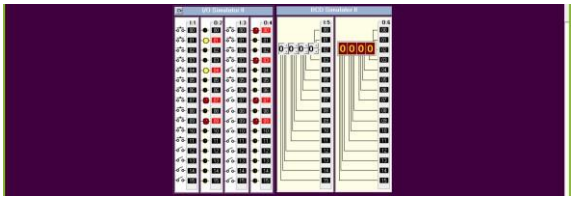
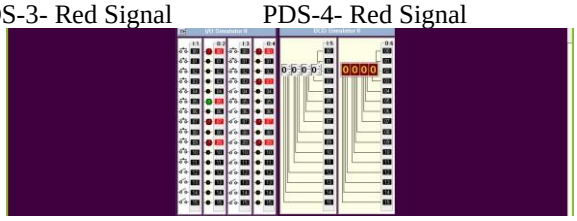


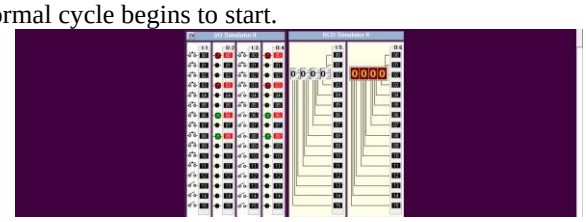
Lane 1- Yellow Signal Lane 2- Yellow Signal
Lane 3- Red Signal Lane 4- Red Signal
PDS-1- Red Signal PDS-2- Red Signal
PDS-3- Red Signal PDS-4- Red Signal



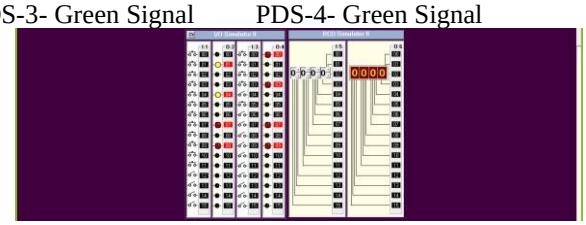
Lane 1- Red Signal Lane 2- Green Signal
Lane 3- Red Signal Lane 4- Red Signal
PDS-1- Red Signal PDS-2- Red Signal
PDS-3- Red Signal PDS-4- Red Signal

2. Pedestrian Cycle:-

The output of the pedestrian cycle is shown below. Here, when we needed a pedestrian signal green, we pressed the start pedestrian push button. This will start only when the normal cycle moves from green to yellow. The green light blinks for 10 seconds, and after that, the normal cycle begins to start.



Lane 1- Red Signal Lane 2- Red Signal
Lane 3- Red Signal Lane 4- Red Signal
PDS-1- Green Signal PDS-2- Green Signal
PDS-3- Green Signal PDS-4- Green Signal

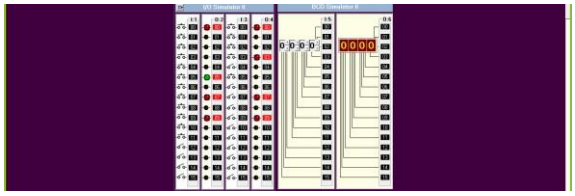


Normal Cycle after Pedestrian Cycle

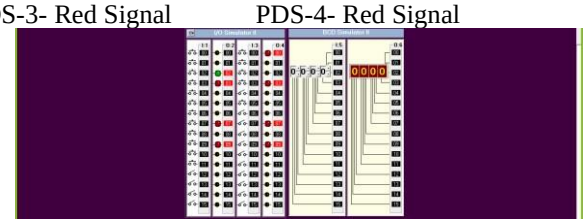
Lane 1- Yellow Signal Lane 2- Yellow Signal
Lane 3- Red Signal Lane 4- Red Signal
PDS-1- Red Signal PDS-2- Red Signal
PDS-3- Red Signal PDS-4- Red Signal

3. Priority Cycle:-

The output of the priority cycle is shown below here when the normal cycle lane 2 shows green light and all other shows red light, but we have need to open lane 1, So to open lane 1 we pressed start priority push button of lane 1 and green light is blinks until we pressed stop push priority button for lane 1 and for this time all other signal shows red lights.



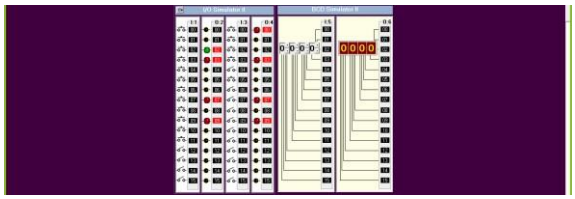
Lane 1- Red Signal Lane 2- Green Signal
Lane 3- Red Signal Lane 4- Red Signal
PDS-1- Red Signal PDS-2- Red Signal
PDS-3- Red Signal PDS-4- Red Signal



Lane 1- Green Signal Lane 2- Red Signal
Lane 3- Red Signal Lane 4- Red Signal
PDS-1- Red Signal PDS-2- Red Signal
PDS-3- Red Signal PDS-4- Red Signal

4. High Density Cycle:-

In case of high density in real or live action we used sensors, but in our case we will put it into a police man who will increase time according to need. As we showed, if a police man sees the lane 1 has a high density of vehicles, they will press a push button to increase the time of the timer from 30 to 45 seconds.



Lane 1- Green Signal Lane 2- Red Signal
Lane 3- Red Signal Lane 4- Red Signal
PDS-1- Red Signal PDS-2- Red Signal
PDS-3- Red Signal PDS-4- Red Signal

The project has generally broaden our understanding of the principles of operating on advance for traffic lighting control systems, particularly on the professionalism of electrical engineering, and has familiarized us with some component specific and related defects and frequent problems with electronic circuits and systems, and how these defects can be overcome.

9. FUTURE SCOPE

- Controlling Traffic by SCADA System
- Continues Traffic Tracking by GPS System
- Use of sensor to detect theft car
- Use of sensor to detect over speeding vehicles

10. CONCLUSION

We considered a lot of research and studies, but all of them have the same general objective that is to build the traffic monitoring system which is advanced and smart from old traffic lights. The methods used in this research are mainly based on the number of vehicles which is being determined by inductive loop sensors, and the conversion of these

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integers to binary is done by an RFID sensor, as mentioned in upper sections. The project which is being built is four way roundabout and is operated by PLC. The PLC used here in this project is Allen Bradley. The ladder logic diagram of the project and the outputs are also mentioned in this report. There are four main cycles in this project that is normal, pedestrian, high density and priority cycle as explained in upper section.

Finally, the main purpose of this project is to pass the pedestrian securely, reduce road traffic and mishappening. All of them have been achieved in this project, and the model is working quite as per needs

REFERENCES

[1] M. Groover, Automation, Production systems, and computer-integrated manufactring 4th edition, Pearson, Aug 2014.

[2] "SMART TRAFFIC CONTROL SYSTEM USING PLC and SCADA" Prerna, Sumedha Sharma, Shubhendu Sachin, Mohit Dev Srivastava, Utkarsh TISSN: 2319 – 8753 , International Journal of Innovative Research in Science, Engineering and Technology Vol. 1, Issue 2, December 2012.

[3] Sree Rajendra2, Sharath H K 4, Shivashankara B S3, Ranjith A V1 "Intellectual 4way Traffic Control System Using PLC and SCADA", June 2018.

[4] Santhoshs Hebbar, Rajeshwari Sundar, and Varaprasad Golla "Implementing Intelligent Traffic Control System".

[5] Oprea C, Erdei Z, Barz C, Petrovan F and PopVadean A 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.

[6] A. K. Emad , "An intelligent traffic light monitor system using an adaptive associative memory," International Journal of Information Processing and Management, vol. 2, no. 2, pp. 23-39, 2011.

[7] Y. Liu and X. F. Chen, "Design of traffic lights controlling system based on PLC and configuration technology," 1st International Conference on Multimedia Information Networking and Security, MINES 2009, vol. 2, no. Nov 2009, pp. 561-563, 2009.

[8] M. A. Khattak, "PLC Based Intelligent Traffic Control System," International Journal of Electrical & Computer Sciences IJECS-IJENS, vol. 11, no. 06, pp. 69-73, 2011.

[9] R. Martínez-rodríguez-osorio, M. Calvo-ramón, A. Miguel and L. C. Navarrete, "Smart control system for LEDs traffic-lights based on PLC," in Proceedings of the 6th WSEAS International Conference on Power Systems, Lisbon, Portugal, 2006.

[10] K. Finkenzeller, RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio frequency identification and near-field communication, West Sussex, UK: John Wiley & Sons Ltd, 2010