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Smart Traffic Control System based on Vehicle Density using PLC

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Abstract: Traffic signals are the most convenient method of controlling traffic in a busy junction. Present traffic signals fail to control the traffic effectively when a particular lane has got more traffic than the other lanes. PLC or Programmable logic controller was used to control a mechatronics system using specific functions. The intelligent or "Smart Traffic Control" is one which would be able to calculate the vehicle density in a lane at a 4-way crossing and then decide the priority automatically using a program. In PLC the status of the sensors are checked and certain logical operations are performed to decide which lane is to be serviced first and provides output signal to the traffic lights poles for ON or OFF the Red, yellow or Green lights and ON time is depend on the specific priorities.

Keywords: Traffic control, PLC vehicle density, smart traffic control.

1. 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.

An Intelligent Traffic Control System senses the presence or absence of vehicles and reacts according to the sensors output. In this system PLC takes a data from sensors and checks the priorities.

2. 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.

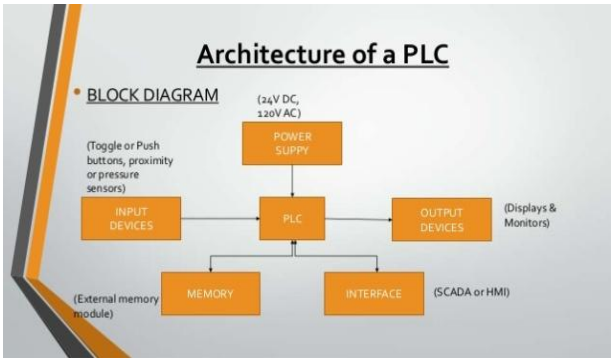

Fig.2.1.Programmable logic controller

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

3. TRAFFIC CONTROL SYSTEM

Traffic Control Systems are used at a point where there are more than two paths for passage of vehicles or wherever passage is to be given to pedestrians to cross a road. These systems are also put in a place at points where there are by-lanes attached to the main road. The main aim of a traffic control system is to control the flow of vehicles through a lane and prevent accidents or road blockages. They are used at points wherever a vehicle needs to stop.

In India the traffic control system is mostly based on sequential logic. Each signal operates for a given period one after the other. The programming is so done that two lanes won't have the same signal at the same time. The traffic control systems at a certain places are even controlled manually by traffic personnel but human error calls for automation to prevent accidents.

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3.1 Brief history

- J. P. Knight created the first traffic signal which was developed in London, England in 1868.
- The modern traffic light was invented in America. New York had installed a three color system in 1918 which was operated manually from a tower in the middle of the street.
- In 1923 Garrett Morgan patented an electric traffic light system using a pole with a cross section on which the words STOP and GO were illuminated.
- In 1926, first automatic signals were installed in London; they depended on a timer to activate them.
- A better idea was the inductive-loop device: a loop of wire was embedded in the road and connected to a box controlling lights; a current of electricity passesthrough the loop, and when the steel body of cars passed over, it produced a light activating signal.

3.2 Present scenario

In the conventional traffic control system it may be observed that the time of Green light glowing for a particular road will be always constant. Sometimes it may happen that, one particular road may be crowded more than other.

Drawback

- Congestion, air pollution and fuel consumption.
- Excessive delay.
- Frustration especially in hot weather.

4. SMART TRAFFIC CONTROL SYSTEM

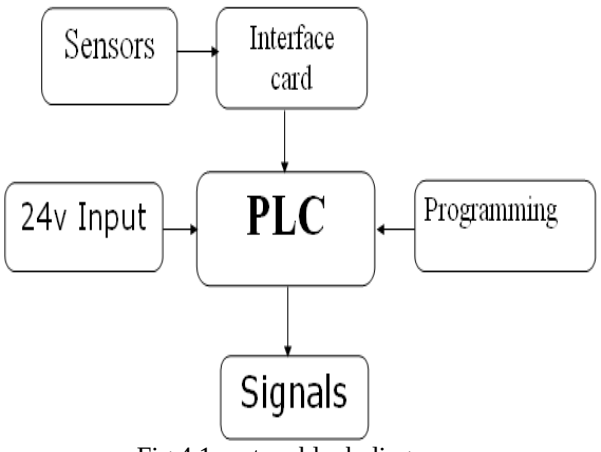

Fig.4.1.system block diagram

To overcome the drawbacks of present traffic signal a Smart Traffic Control System atomizes the traffic control activity and uses certain logical and mathematical operations and derives priority order of the lanes based on certain factors and hence controls the traffic in an optimized manner. It uses inputs from sensors and sends interrupt signals to the controlling unit which in turn handles the operation of traffic signals automatically. System measures the traffic density on each road by counting the number of vehicles and then takes the decision. Programming is done using ladder diagram.

4.1 Need for Smart Traffic Control

- Increasing number of vehicles and lower phase of highways developments have led to traffic congestion problem.
- Time of travel, environment quality, quality of life and road safety are all adversely affected as a result of traffic congestions.
- Delays caused due to traffic congestions indirectly affect productivity, efficiency, and energy losses.
- Human error can cause mismanagement.
- Emergency situations like medical emergencies, construction work, accidents, etc.

4.2 Modes of Working

Traffic load is dependent on factors such as time, day, season, weather and unpredictable situations like accidents or construction activity or any special event. The main aim is to minimize waiting time for each lane as well as serving the busy lanes as much as possible. The system can be divided into four main parts**:**

- Hardware Model
- Programming
- Sensors
- PLC

The objective is to build a prototype that has the ability to collect information of the busy tracks by sensors and using a control unit to shift service to a given lane as per priority. An intelligent traffic system works in different modes:

1. Normal flow
2. Peak flow
3. OFF time

- Normal flow occurs when the traffic in a lane is less than a certain fixed threshold value. In this time the traffic signals operate sequentially.
- Peak time is the period in which the traffic density crosses the threshold value in a given lane.
- OFF time occurs when there are no vehicles and during this period signals turn off automatically or continuously yellow signal.

In the practical design IR obstacle sensors are used to detect the presence of vehicles at intersections. Its basic function is to provide interrupts to control units.

4.3 Practical Design

Four sensors have been placed on the roads 1, 2, 3 and 4 as shown in Fig.3.The sensor is placed at a distance away from the junction so that it doesn't get disturbed by the vehicles stopping at the signal. These sensors are connected to the PLC, which counts the pulses coming

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from the sensors based on the count output is given to the LEDs. In this design, photo electric sensors provide an interrupt signal to controller unit. In case when vehicle reaches in front of sensors, then it provide an interrupt signal. It has built in transmitter and receiver. This sensor works on PNP condition means that when object is placed in the range of the sensor then it provides output.

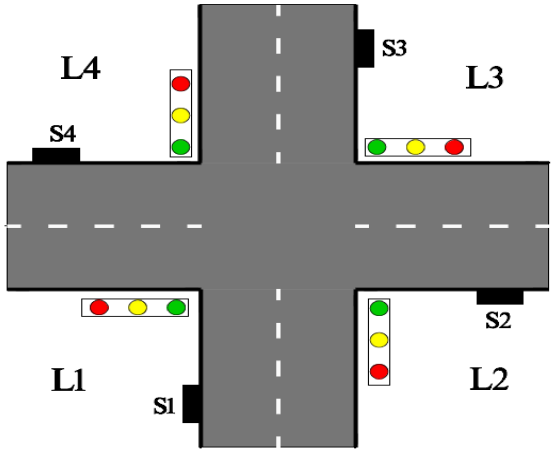

Fig.3. Practical design

4.4 Advantages of Smart Traffic Control System

A properly ordered Smart Traffic Control System can

- Provide for orderly movement of traffic
- Reduce frequency and severity of certain kind of clashes
- Interrupt heavy traffic to allow pedestrians to pass
- Effectively perform traffic management
- Provide priority to high vehicle density lane
- Be efficient compared to conventional system

5. PROTOTYPE HARDWARE

Hardware components used
The basic hardware components that have been used are

- DELTA PLC Kit
- Sensors
- LEDs
- Relay Board
- RS232 Cable

6. SOFTWARE IMPLEMENTATION

WPL Software is a program editor of Delta DVP series PLC for WINDOWS computers. In addition to general PLC programming and WINDOWS editing functions (e.g. Cut, paste, copy, multi-window display, etc.), WPL Software also provides various comment editing as well as other special functions (e.g. register editing and settings, file accessing and saving, contacts monitoring and setting etc.).

7. LADDER DIAGRAM

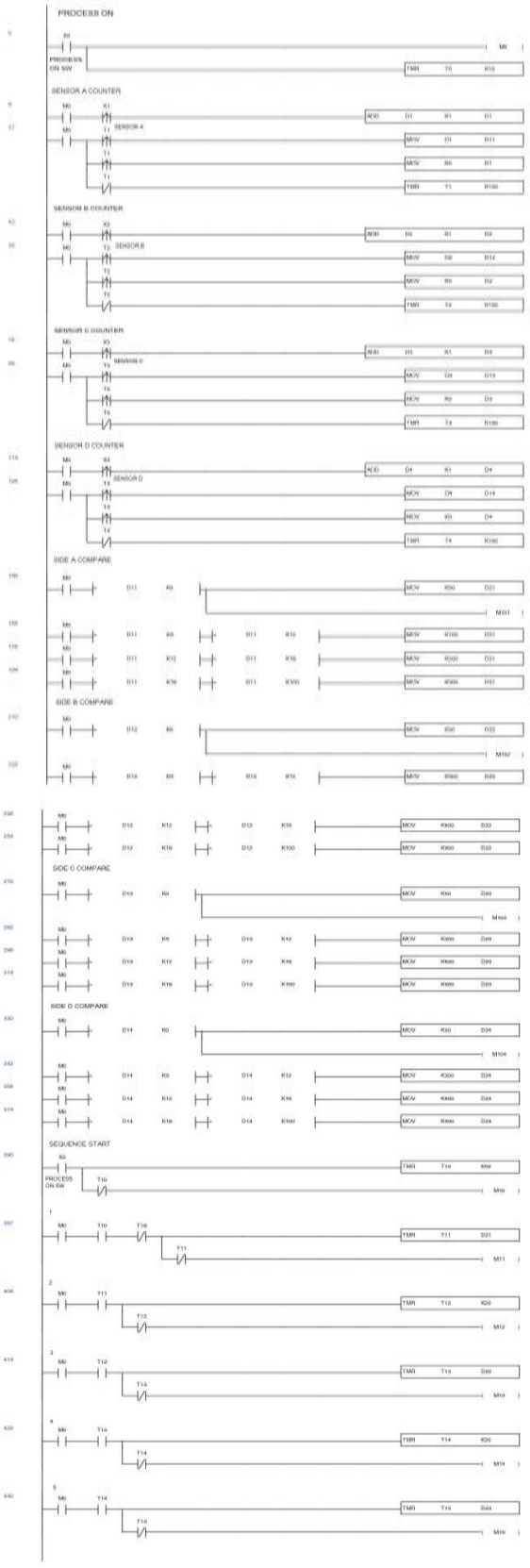

Fig.7.1.Ladder Diagram

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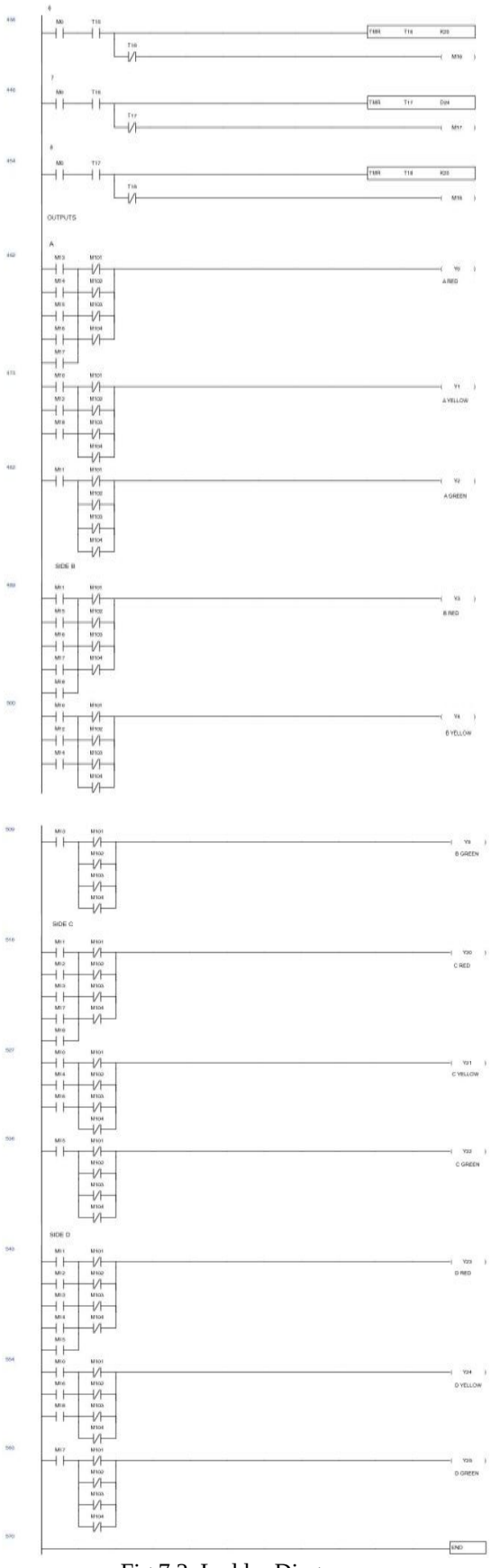

Fig.7.2 .Ladder Diagram

8. RESULTS

The ladder diagram is dumped into PLC and the model is given power supply. As a result the traffic system operates in a sequential order servicing one lane after the other. The sensors monitor all the lanes and depending on the sensor output priority is given to the lanes.
Green signal for lanes is given based on the number of vehicles. In case of no vehicles signals turn off automatically. As a result of this all lanes get service but lane with high density gets higher preference.

8.1 Tabulation

The following tabulation gives the reading for a particular example. When lane 1 is having 5 to 12 vehicle density, all the lane vehicles are supposed to wait for 10 seconds.As shown in table 8.1.

Table 8.1

Density	Lane	Red	Yellow	Green
5 to 12	1	OFF	2sec	10sec
	2	10 sec	OFF	OFF
	3	10sec	OFF	OFF
	4	10sec	OFF	OFF

When lane 2 is having 12 to 18 vehicle density, all the lane vehicles are supposed to wait for 20 seconds. As shown in table 8.2.

Table 8.2

Density	Lane	Red	Yellow	Green
	1	20sec	2sec	OFF
12 to 18	2	OFF	2sec	20sec
	3	20sec	OFF	OFF
	4	20sec	OFF	OFF

When lane 3 is having above 18 vehicle density, all the lane vehicles are supposed to wait for 30 seconds as shown in table 8.3.

Table 8.3

Density	Lane	Red	Yellow	Green
	1	30sec	OFF	OFF
	2	30sec	2sec	OFF
Above 18	3	OFF	2sec	30sec
	4	30sec	OFF	OFF

When lane 4 is having 5 to 12 vehicle density, all the lane vehicles are supposed to wait for 10 seconds. As shown in table 8.4.

Table 8.4

Density	Lane	Red	Yellow	Green
	1	10sec	OFF	OFF
	2	10 sec	OFF	OFF
	3	10sec	2sec	OFF
5 to 12	4	OFF	2sec	10sec

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Duration of red signal in all other three lanes considering 5 to 12 vehicle density in each lane. As shown in table 8.5.

Table 8.5

Density	Lane	Red	Yellow	Green
5 to 12	1	OFF	2sec	10sec
	2	10sec(because of green signal in lane 1)	OFF	OFF
	3	20sec(because of green signal in lane 1&2)	OFF	OFF
	4	30sec(because of green signal in lane 1,2&3)	OFF	OFF

9. CONCLUSION

The traffic light is successfully controlled by PLC. An intelligent traffic signal had successfully been designed and developed. The sensors were 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. Increasing the number of sensors to detect the presence of vehicles can further enhance the design of the traffic light system. Thus the proposed system would make our roads a safer place to travel.

10. FUTURE SCOPE

The proposed approach will consider not only the priority of the vehicles but also the density of the vehicles on the road and also will control the traffic light sequence efficiently and more accurately and the accuracy of the PLC is more than that of a sequential system. This system aims at saving a large amount of man hours caused by traffic problems and accidents, where prevention can save lives and property. It is able to manage priority emergency tag vehicles. A lot of development ideas for work in future such as using solar energy (independent power supply, i.e. saving the power). It is possible to use the noise sensors or gas sensors to control the timing of timers and counters in traffic nodes, so the sub program will be called for doing the mentioned purpose. Using the GPRS map as an additional step for development and choosing the best road for the emergency and police vehicles.

REFERENCES

[1] "PLC Based Intelligent Traffic Control System", Muhammad Arshad KhattakInternational Journal of Electrical & Computer Sciences IJECS-IJENS Vol: 11 No: 06

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

[3] "Adaptive Intelligent Traffic Control System using PLC ",S.V.Viraktamath, Priyamvada Holkar, PriyankaV.Narayankar, Jayashri Pujari International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 1, January 2015

[4] Programmable Controllers Theory and Implementation, Second Edition L.A. Bryan, E.A. Bryan

[5] Programmable Logic Controllers,Fourth Edition W. Bolton

[6] Programmable Logic Controllers: Programming Method sand Applications, John R. Hackworth and Frederick D. Hackworth

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