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PLC Based Traffic Density Control Using Sensor

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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. 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. The paper presents the traffic control system controlled through a PLC (Programmable Logic Controller) which takes the signals from different sensors on roads. 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 – Programmable Logic Controller (PLC), Counters, Weight Sensors, Traffic Control

1. Introduction

These days it is necessary to introduce a system of traffic control to be implemented in the city with high traffic. In order to implement such a system, it has to be implementable globally, at the level of an entire city, with knowledge of the geographical factors, of the infrastructure of the public roads, daily/weekly routes etc. In an intersection the problem is local in nature. Ignoring the influence that the road infrastructure has in an intersection, one needs to establish the priority road, the traffic flow and the pedestrian flow. A regularly signalized intersection is programmed in a pre-established manner, the green time and the red time are periodically adapted, or not at all, at long time intervals, depending on the traffic flow [1]. At the same time, times are changed depending on the traffic flow at certain rush hours which are unchanged. There are certain settings, such as green light for pedestrians or green light for a certain lane, which are operational even if it is not necessary. This paper approaches the development of an adaptive system which knows the traffic flow in real time based on receiving certain signals from various sensors, and then, depending on theses, changes the times of statuses and eliminates certain statuses between red light and green light which are not necessary under certain circumstances.

A traffic light group is defined as a set of traffic lights which are controlled by the same regulator, which acts as a master or coordinator. The regulator operates under a intelligent system that allows for controlling the lights status depending on time, traffic conditions, etc. Urban traffic control strategies are based on lights controllers. An intersection is managed by a controller in charge of several red lights. The management is based on phases, cycles, split vectors and coordination between the controllers of the different intersections on the road network. To implement the applications indicated, a certain level of intelligence is required in both the traffic light and the regulator. Traditional traffic control systems are unidirectional,

from regulator to traffic lights, without any response from the status of the traffic lights [2]. One strategy for optimum control and traffic management is the coordination of traffic lights to create green waves. Currently, there exist different strategies to calculate green waves. The main purpose of these techniques is to reduce the number of stops and minimize the travel times in trips.

2. Process Description

2.1 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.

2.2 Need for Smart Traffic Control System

Due to 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.

2.3 Smart Traffic Control System

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. The block diagram of smart traffic control system is shown in figure 1.

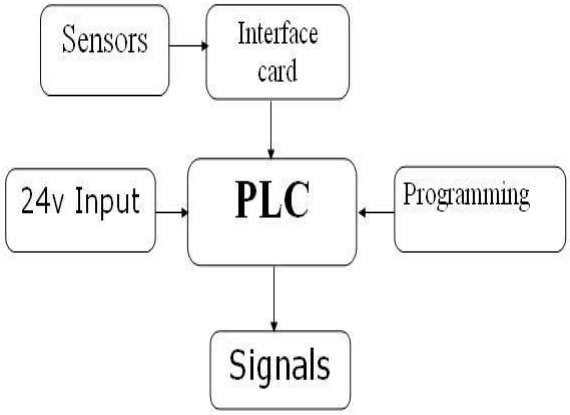

Fig 1.System Block Diagram

In this method we are proposing to reduce the heavy traffic and congestion on the road by using PLC based traffic diversion system. This would work on weight sensing using sensors whose output will be fed to a PLC, which will control the traffic diversion. This method is in two parts:

i. Diversion

Weight sensor is placed at toll booth. It senses the weight & sends signal to PLC. PLC will generate a slip having the info about the vehicle in the form of barcode. PLC will give the diversion according to the weight of the vehicle. Fig. 2

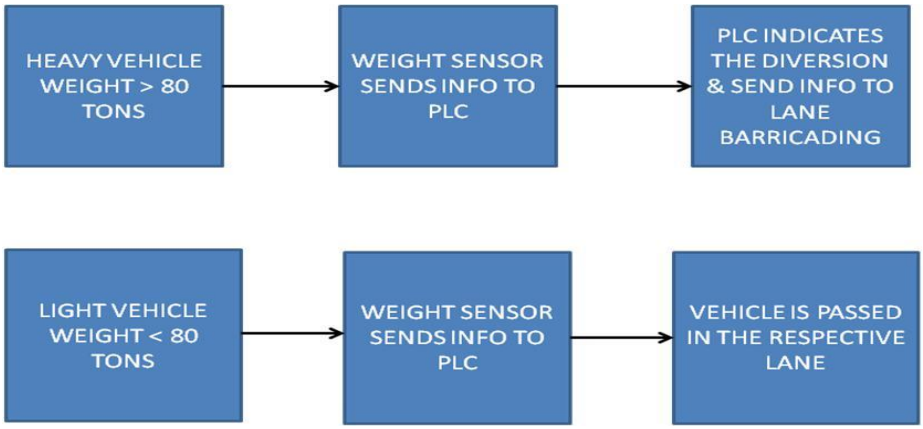

Fig. 2 Flow Chart for Diversion of Vehicles Based on Weight

ii. Congestion Control

In this there are two counters– UP Counter (at the starting of the road) & DOWN Counter (at the end of the road) whose max value is 100. When a vehicle enters the road, UP Counter is set and vice versa. There are 3 conditions for allowing the vehicle in the area Fig. 3

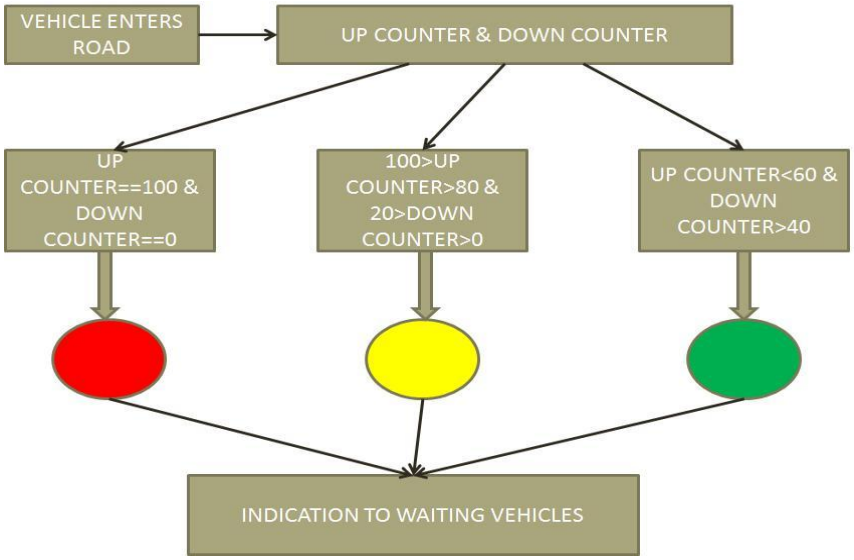

Fig. 3 Flow Chart for Diversion of Vehicles Based on Traffic Density

- If UP Counter==100 & DOWN Counter==0, then red light will be shown i.e. no vehicle will be allowed to enter the area.
- If 100>UP Counter>80 & 20>Down Counter>0, then yellow light will be shown i.e. vehicles will be told to be ready to enter the area.
- If UP Counter<60 & DOWN Counter>40, then green light will be shown i.e. vehicles will be allowed to enter the area.

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 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 provides 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.

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.

3. Conclusion

In the context of present-day urban traffic one needs to implement signalizing systems which would ensure the best traffic conditions. This method will help reduce congestion on roads and would help in coping with accidents as the heavy vehicles and light vehicles will be in different lanes. The signalizing system can be implemented at the level of an intersection with four roads and two lanes per direction. At the entry points with delays one can apply signals, impulses (which come from sensors or are actuated manually) which will have effect in the prolongation of the green late for the selected road. The graphical interface clearly renders the functioning of the signalizing system, as well as the applied delays. Resultantly, a solution to a much critical problem of traffic congestion and fatal accidents is possible using this system.

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