A Novel Approach for Dynamic Road Traffic Management System (DRTMS) with Lab VIEW and Arduino

Gabriel Kapapula[1], Pardeep Mittal[2]

[1] *Student of Electronics and Electrical Engineering, Lovely Professional University, India*
[2] *Assistant Professor, Department of Electronics and Electrical Engineering, Lovely Professional University, India.*

Abstract -***Vehicular traffic is continuously increasing around the world, especially in large urban areas. The resulting congestion has become a major concern to transportation specialists and decision makers. The existing methods for traffic management, surveillance and control are not adequately efficient in terms of performance, cost, maintenance, and support. In this proposed scheme, the design of a system that utilizes and efficiently manages traffic light controllers is presented. In particular, we presented an adaptive traffic control system based on a new traffic infrastructure using density based traffic control using new techniques like Arduino Processor and LAB VIEW programming for controlling the traffic flow sequences. The infrared sensors are used to detect vehicle density on road and control traffic signals roadways, while an intelligent traffic controller is developed to control the operation of the traffic lights. The LAB VIEW and Arduino embodies traffic system communication algorithm (TSCA) and the traffic signals time manipulation algorithm (TSTMA). Both algorithms are able to provide the system with adaptive and efficient traffic estimation represented by the dynamic change in the traffic signals' flow sequence and traffic variation. Simulation results show the efficiency of the proposed scheme in solving traffic congestion in terms of the average waiting time and average queue length on the isolated (single) intersection and efficient global traffic flow control on multiple intersections.***

Key Words: *Traffic management, Traffic Lights, Density measurement, dynamic control, Lab VIEW, Arduino*

1. INTRODUCTION

Traffic congestion is a severe problem in almost every modern cities around the world. Traffic congestion has been causing many critical problems and challenges in the major and most populated cities. To travel to different places within the city is becoming more difficult for the travelers in traffic. Due to these congestion problems, people lose time, miss opportunities, and get frustrated. Traffic congestion creates direct impacts the companies. Due to traffic congestions there is a loss in productivity from workers, trade opportunities are lost, delivery gets delayed, and thereby the costs goes on increasing. To solve these congestion problems, we have to build new facilities and infrastructure but at the same time make it smart. The only disadvantage of making new roads on facilities is that it makes the surroundings more congested. So for that reason we need to change the system rather than making new infrastructure twice. Therefore many countries are working to manage their existing transportation systems to improve mobility, safety and traffic flows in order to reduce the demand of vehicle use. By enhancing public transport, route guidance systems, traffic signal improvements, and incident management, congestion can be improved greatly from the statistical analysis of US department of transportation in 2007, it has been found that half of the congestion caused is due to the recurring congestion. Due to recurring congestion, the roads have been used repeatedly when they were not supposed to be used twice. These congestion problems are recurring congestion problems are caused due to poor guidance of travelers. The other half of the congestions are due to the non-recurring congestions which are due to traffic incidents, work zones, weather on special events. Non-recurring events dramatically reduce available capacity and reliability of the entire transportation system.

2. Block Diagram of Proposed Scheme

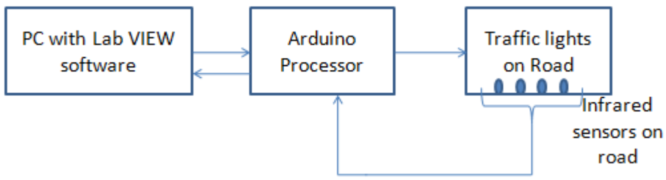

Fig 1: Block diagrams of proposed scheme

The block diagram of implementation of proposed scheme is illustrated in Fig.1. Multiple IR sensors has been installed on road for density measurement. Increases the number of IR sensors improves the accuracy of density measurement but also cost increases. Data can be read/write from Lab VIEW to Arduino Processor and vice-versa. Traffic lights are connected with output port of Arduino processor and IR sensors are connected with input port of Arduino processor through feedback path. Here Arduino processor act as interfacing device which support the Lab VIEW software. Intelligent algorithm in Lab VIEW has been developed for better decision making respective to traffic density on road. If there is small congestion then timing of Red/Green would be change according to density measured on the road. But in the case of heavy congestion the yellow lights would be blink for indicate collapse. In India 10:00PM to 08:00AM timings of traffic lights are set for blink the yellow light indicates the vehicle must go on. In this scheme blinking of yellow light between 08:00AM to 10:00PM will indicate collapse. The intelligent decision making algorithm's result manuplates the timing of green signals/red signals.

3. Flow chart of proposed scheme

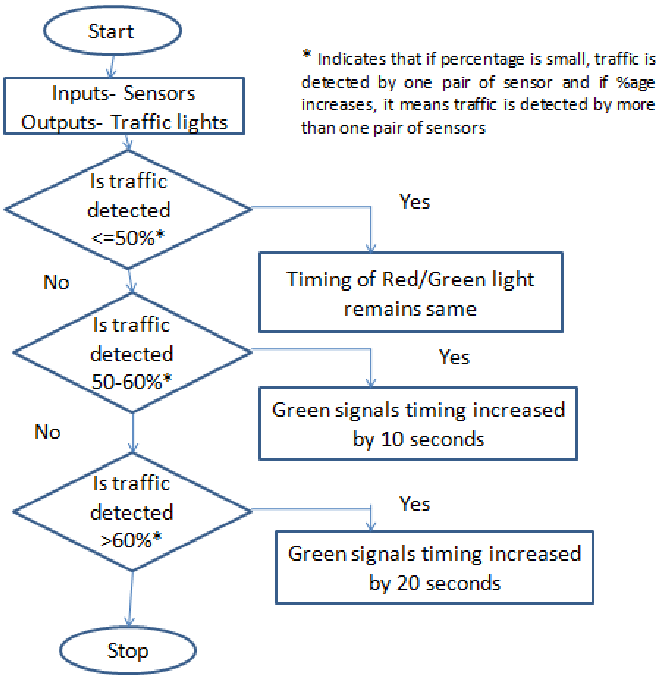

Fig.2 Flow chart of proposed scheme

Flow chart of proposed scheme is shown in fig.2. If traffic is found less than or equal to 50%(here first pair of sensor if detects traffic, means normal traffic is there so no need to change the timings i.e timing will remain same as set earlier, if 2nd pair of sensor detects traffic means traffic is 50-60% and Green signals timing increased by 10 seconds and so on. These timings are arbitrary and flexible, means timings can be set as per requirement.

4. Implementation of DRTMS

4.1 Circuit Diagram

As we have taken T type road to check performance of proposed scheme, total there are six IR sensors (2 sensors in 3 pairs) and 9 traffic lights (3 Red, 3 Yellow and 3 Green) on three roads meeting at a junction. Arduino processor as a hardware interfacing device is connected with IR sensors and Traffic lights.

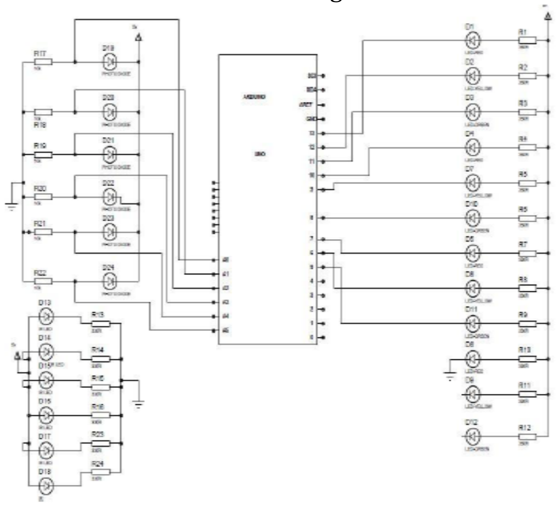

Fig.3 Hardwired Diagram of Proposed system

4.2 Scheme Description

Fig.4 Prototype Model of Proposed system

Initially the signals are started by giving the power supply from the Arduino. The first step is to make sure that the signals are all in ON condition. During this all the traffic signals will blink in initial condition. This indicates that they are all in the working condition.

The next step is to check for the density of traffic in these roads. By density what we are trying to mean in that the number of vehicles available in a particular at a certain period of time. The density is calculated over here by means of using an IR circuit and then the density sensing from IR sensors given to the Arduino and it sends to the LAB VIEW. Depending on the number of vehicles that cut the light travelling from the receiver to transmitter of the IR circuit the count of the vehicles is registered in the Lab VIEW Software.

This is followed by the next step in which the LAB VIEW decides as to which road should be given the highest priority. Lab VIEW gives the output to the Arduino and it will give output sequence of traffic light LEDs. This is based on the density of traffic on road.

The very next step is to assign time delays for each road. The time delays have already been set for certain specific counts in the Lab VIEW. As soon as the Lab VIEW receives the counts from the IR circuit it will immediately detect the density of each road and accordingly allot the time delays for which each signal will show the green light. The higher the traffic density, the longer will be the Green time delay allotted.

In the final step, the Lab VIEW makes sure that the lowest density road is also opened and that the delay of the green light for that particular signal also comes to an end. Once all the roads are opened in a sequence, then the LAB VIEW again goes back to the second step where it checks for the density of traffic in each road. The whole process is repeated like a cycle. The main point that is to be noted regarding this process is that, whenever a particular road has no traffic, correspondingly, the yellow light in the traffic signal will glow.

4.3 Lab VIEW

Lab View which means Laboratory Virtual Instrument Engineering Work Bench, is a graphical programming environment which is being used in research labs, in industries and is used for the academic purpose as well. It is graphical programming also known as G-programming is a powerful, versatile type, analysis and instrumentation software system used for measurement and automation.

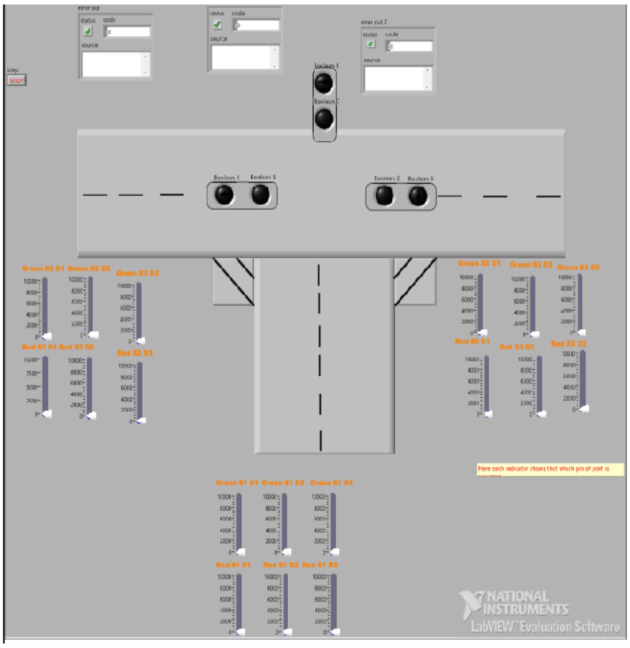

Fig.5 Front panel of proposed scheme

Lab VIEW software has two windows, one is known as front panel which is shown in fig. and Other is known as Block diagram which is shown in fig. . Front panel consists of Input and output devices whereas in block diagram connections are made on basis of required logic. Block diagram uses number of instructions including WHILE, FOR, CASE STRUCTURE etc. like number of looping operational functions.

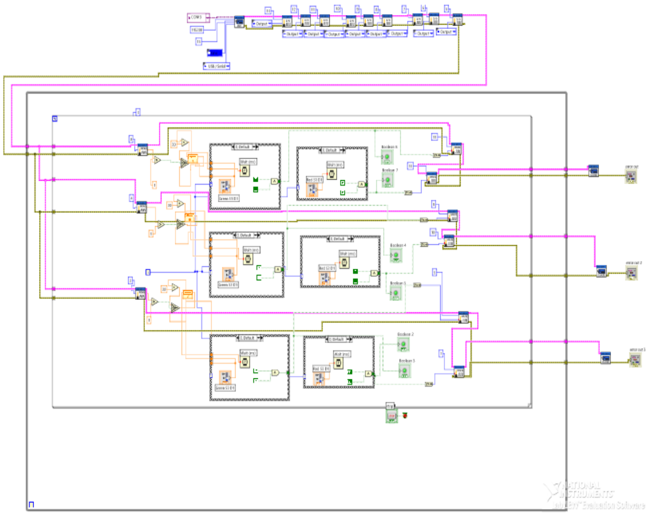

Fig.6 Block diagram (Lab VIEW) of proposed scheme

4.4 Arduino

Arduino is an Electronic device which acts as a interface for transferring input signals from IR sensors to the LABVIEW and output signals from the LABVIEW to the LEDs. It is a device which is pinned with some digital input and output pins and with some analog input and output pins. It acts as an interfacing device and is used to transfer the signals with serial communication.

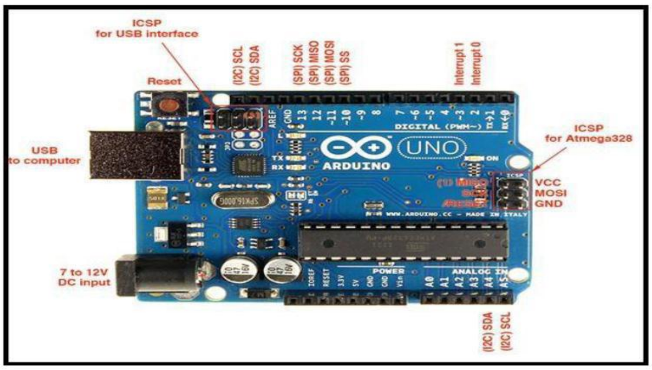

Fig.7 Arduino Processor

Lab VIEW software always requires NI ELVIS devices for data acquisition from/to outside world, but Arduino as a interfacing devices can be interfaced with PC Lab VIEW via USB cable or serial port.

The Arduino UNO has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs.

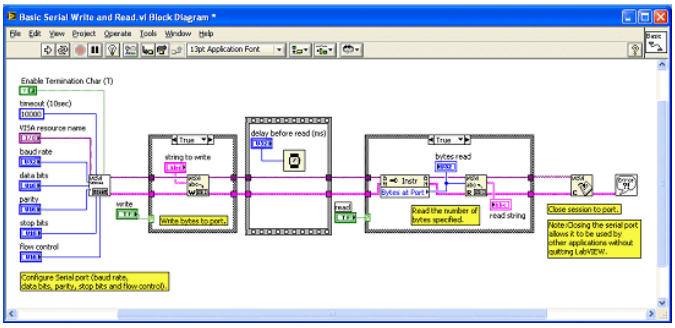

Fig.8 Interfacing program of Arduino with Lab VIEW

Fig 8 shows the interfacing program of Arduino with Lab VIEW. In present time, Arduino is used as function in function palette, but in this scheme VISA source functions has been used to connect it with Arduino processor.

4.5 Parameters considered

4.5.1 Priority on roads

- If two or more roads of equal high priority any one road is opened like traditional traffic control way mostly in clockwise direction.
- If all roads are having no traffic, yellow signal appears.
- No road is allowed to be closed continuously for more than maximum duration
- Without considering the density

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4.5.2 Delay of timings

The delay for each road is chosen according to the density

- Low-10seconds
- High-20seconds

5. Simulation Results

The performance of the dynamic traffic controller can be evaluated by comparing it with the fixed-time controller. This can be done by using the Controller facility where both the controllers are to be simulated. There are two types of simulation tests that can be carried out. One is the fixed flowrate and the other is the varied flowrate. The varied flowrate allows slightly complex traffic situation which reflects real-life conditions. In order to make comparisons between the dynamic controller and fixed-time controllers, identical conditions have to be set during the simulation. In order to see the effectiveness of the controllers, we set higher traffic density for one of the lanes. Fig. 9 shows the traffic flow density for both systems that have been set for twenty four minutes of simulation time. One minute in the simulation is equivalent to one hour in real-life conditions. The flow densities for the lanes are varied differently every minute using the Flow rate facility to reflect real-life traffic conditions.

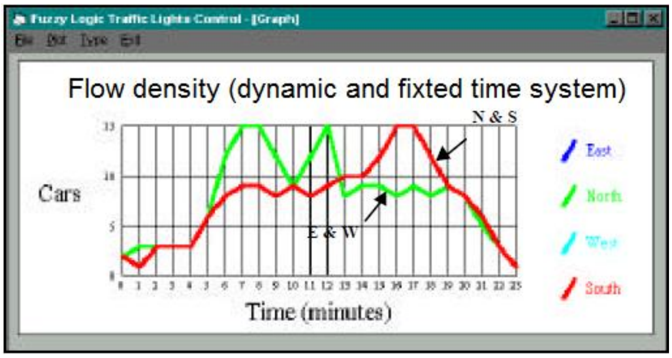

Fig.9 Flow density (dynamic and Fixed time system)

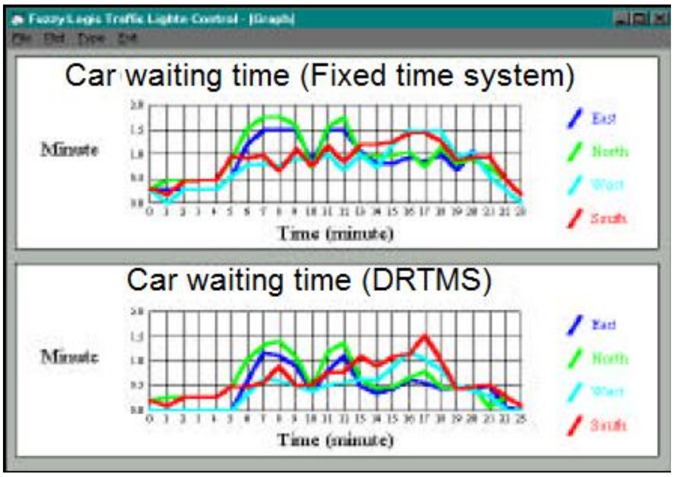

Fig.10 Car waiting time (Fixed time system and DRTMS)

6. CONCLUSIONS

The dynamic traffic lights controller performed better than the fixed-time controller or even vehicle actuated controllers due to its flexibility. The flexibility here involves the number of vehicles sensed at the incoming junction and the extension of the green time. In the fixed-time controller, being an open-loop system, the green time is not extended whatever the density of cars at the junction. For vehicle actuated traffic light controllers, which is an enhanced version of fixed-time controller, the green time is extended,

A simulation experiment was carried out to compare the performance of the dynamic controller with a fixed-time conventional controller. The flow density of the simulation is varied according to real life traffic conditions. It can be observed from the results that the dynamic road traffic management system provides better performance in terms of total waiting time as well as total moving time. Less waiting time will not only reduce the fuel consumption but also reduce air and noise pollution.

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