Peformance of Density based Traffic Flow Regulator

Sankar Kumar S[1], Sabarish K[2], Santhosh Kumar K[3] and Viggnesh Kumar B K[4]
[1]Research Scholar, [2,3,4] UG Students
Department of Electronics and Communication Engineering
Velammal College of Engineering and Technology, Madurai, Tamilnadu, India

***Abstract*— With the advent of science and technology, usage of partially or fully automated existing traffic light controller systems being followed with some limitations then and there, are programmed with fixed time, also called *static*, irrespective of the density of the vehicles present in any direction. Even though the existing method is somewhat appreciable during peak hours, it is killing time during off peak hours that results non-cooperation of public which in turn leads to unexpected situation. In order to overcome such issues, it is essential to design and develop a *dynamic* traffic light controller system to regulate the traffic flow intelligently round the clock according the vehicle density in any direction. In this work, the authors have proposed a 24 x 7 vehicle density monitoring and a clock wise rotating traffic flow intelligent control system which allocates the time accordingly and if no vehicle is detected in any direction a skip action will be taken to provide chance to the next direction in sequence. In addition, introduction of speed reduction of the incoming vehicles during the signal transition from Green to Amber will definitely minimize the unexpected situations at such traffic flow junctions.**

Keywords*— *IR Sensors, RF Module, Traffic flow, Density, dynamic

I. INTRODUCTION

In the modern era so many problems are being faced by common public and one of which is traffic congestion that becomes a serious one day by day since present traffic lights have a conventional setup being provided with fixed signal timing. The major cause leading to traffic congestion is the high number of vehicle which was caused by the population and the development of economy. It is said that the high volume of vehicles, the inadequate infrastructure and the irrational distribution of the development are main reasons for increasing traffic jam. When traffic demand is great enough then the interaction between vehicles slows the speed of the traffic stream results in some congestion. As demand approaches the capacity of a road (or of the intersections along the road), extreme traffic congestion sets in. When vehicles are fully stopped for periods of time, this is colloquially known as a traffic jam or traffic snarl-up. Traffic congestion can lead to drivers becoming frustrated and engaging in road rage. Therefore it is practically important to develop, verify and validate simple yet powerful models that help in designing and improving the safety and efficiency of transportation. As a solution for the above said issues and to avoid the congestion in the traffic, density based traffic light regulating module is needed to reduce the traffic signal delay and travel time especially in developing countries and also it is a severe problem in most of the cities especially in urban environments across the world and it has become a nightmare for the travelers in these cities.

Currently, the Traffic signal timings are static which is supposed to be modernized as a dynamic one. The proposed work “A density based Intelligent Traffic flow regulator” developed for a four way traffic junction having three different density zones namely Low, Medium and High in each directions. The density of the vehicles in the particular zone is detected by means of array of IR sensors and the duration of the GREEN signal timings will be inflated in clockwise manner based on the density accordingly. In case, if no vehicles detected in any of the directions in the junction, the green signal will be skipped and allotted to the next direction automatically thereby the existence of the dynamic traffic controller can be achieved.

Another major drawback of vehicle dashing is non cooperation from the common public while crossing the junction during the signal transition from AMBER to RED. Considering the issue also, in the proposed work in order to avoid such circumstances, it is suggested in this work to reduce the speed of the incoming vehicles in the present clearance direction considerably using RF technology and finally the proposed work is an automated round the clock monitoring and traffic regulator that is a 24 x 7 module which is not existing anywhere.

II. RELATED WORKS

In metropolitan cities the occurrence of traffic congestion at the intersections in cities is one of the major problems. Congestion on roads eventually results in slow moving traffic, which increases the time of travel. Manjunath N proposed in his paper an alternative solution for hassle free movement of ambulance by introducing an automated traffic signal using RFID. The proposed system tries to minimize the possibilities of traffic jams, caused by the traffic lights, by clearing the

road also provides the clearance for the emergency vehicle if any. The proposed project provides ample amount of time for ambulance to not only pass the signal without hindrance but allows for smooth traffic movement in other roads joining a Junction and also quality of service to Emergency vehicles and improves the accuracy of Automatic Traffic Light system.

The existing methods for traffic management, surveillance and control are not adequately efficient in terms of performance, cost, maintenance, and support. Khalil M. Yousef presented in his paper, the design of a system that utilizes and efficiently manages traffic light controllers. In particular, they presented an adaptive traffic control system based on a new traffic infrastructure using Wireless Sensor Network (WSN) and using new techniques for controlling the traffic flow sequences. These techniques are dynamically adaptive to traffic conditions on both single and multiple intersections. A WSN is used as a tool to instrument and control traffic signals roadways, while an intelligent traffic controller is developed to control the operation of the traffic infrastructure supported by the WSN. The controller 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.

In a density based dynamic traffic signal system designed and developed by Bazila banu, the signal timing changes automatically on sensing the traffic density at the junction. Conventional traffic light system is based on fixed time concept allotted to each side of the junction which cannot be varied as per varying traffic density. Junction timings allotted are fixed. Sometimes higher traffic density at one side of the junction demands longer green time as compared to standard allotted time. The image captured in the traffic signal is processed and converted into grayscale image then its threshold is calculated based on which the contour has been drawn in order to calculate the number of vehicles present in the image. After calculating the number of vehicles they will come to know in which side the density is high based on which signals will be allotted for a particular side. Raspberry pi is used as a microcontroller which provides the signal timing based on the traffic density.

It is inferred from the related works developed so far though the density based traffic flow system exists, it is an expensive one with some complexity and during signal transition especially from AMBER to RED, due to non-cooperation of public, there are possibilities for vehicle crash. In order to overcome those issues a cost effective density based traffic flow regulator is proposed. The authors also concentrated in the speed control of the vehicles which enter in the active density region which feature is not available in the existing density based traffic control method. The block diagram, complete functional flow diagram of the proposed work that describes the overall function of the system, the experiments carried out with the developed module and results obtained during experimentation are detailed in the following section.

III.PROPOSED WORK

With the advent of science and technology, researchers are working on providing technical solutions for the issues which are mostly growing among us and embedded system is one of the domains that plays vital role in the launch of various automated intelligent systems. In this paper, the authors have identified some problems in the existing density based traffic light controller method which is discussed in the earlier section and to overcome those issues they have proposed a novel idea in their work. The proposed work's block diagram is shown in Figure 1.

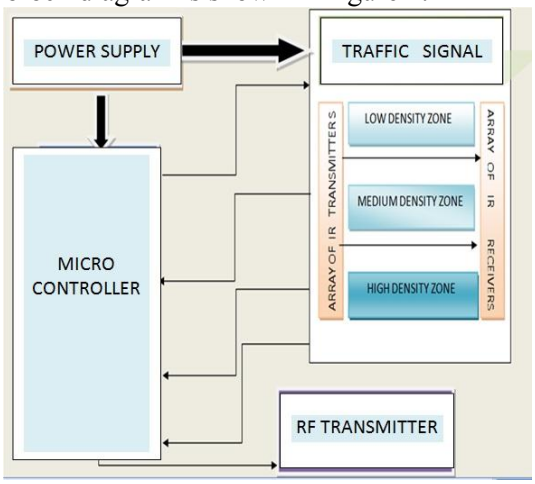

Fig.1 Block diagram of the proposed work

Even though the existing density based traffic light control system is a dynamic one, the idea introduced was to count the number of vehicles in all the sides by capturing the traffic image and using image processing technique the count will be accounted, which is an expensive and complex one. According to the count the density will be taken for further action.

In the proposed work, a cost effective regions are allocated such as Low, Medium and High using IR Transceiver arrays. With respect to the density of vehicles present in a particular direction that is received from the IR Transceiver arrays the time allocation will be provided to permit the vehicles in that direction. For example, if the density is Low means 15 seconds timer will be enabled. Similarly for Medium 30 seconds timer and for High 45 seconds timer will be enabled. Moreover, the direction will be chosen in a cyclic and

clock wise manner, that is North to East, East to South, South to West and West to North.

Since the proposed work is related to dynamic traffic flow, to have a smooth traffic regulation, in the absence of vehicles in any of the directions while performing the clockwise switching, the direction at which no vehicles are present will be skipped and choice will be given to the next possible direction. In case of continuous high density occurrence in any of the directions due to some unavoidable reasons, then the permission timer attempts will be provided twice or thrice at once, thereafter the signal will be switched to the next sequence.

In addition, during the signal either at AMBER or transition from AMBER to RED, by enabling the RF transceivers one at signal point and the other at the vehicle, the speed of the vehicle will be reduced when it enters the region between Low and High automatically if the driver doesn't do it thereby unwanted crash of vehicles shall be prohibited. Moreover, the density computation will always be done from Low. If it is present then the other two levels will be verified and accordingly the timer will be activated. The developed complete functional flow diagram of the proposed traffic flow regulator is shown in Figure 2.

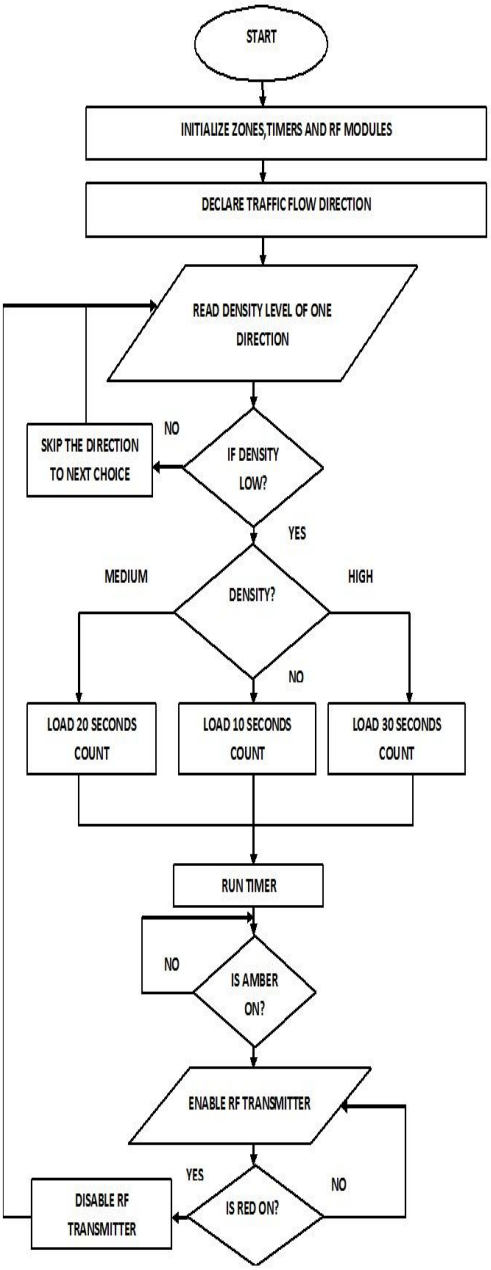

Fig. 2 Functional flow diagram of the proposed work

IV.RESULTS AND DISCUSSIONS

The authors have started their work by designing the circuit diagram of the proposed model using 89C51 microcontroller along with RF and IR Transceivers, LCDs, a motor circuitry and R,Y,G Traffic signal panel with their driver circuits. The design comprises two sections viz., density based traffic flow regulator and the vehicle speed controller. The schematic diagram of density based traffic flow regulator is shown in Figure 3.

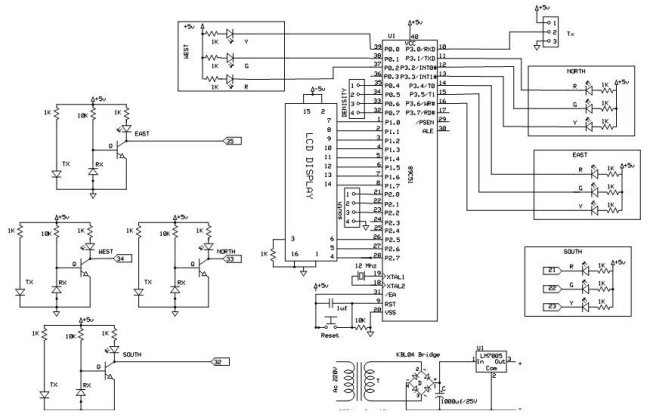

Fig. 3 Schematic diagram of Traffic flow regulator

The attractive features of inexpensive, quick response time and sensitivity impressed the authors to choose IR technology to incorporate in this work. Initially, IR Transceiver is assembled and performance of the same is experimented. The response of the IR module is appreciable and so two more IR Transceivers are also developed to satisfy all the three regions i.e., Low, Medium and High of one traffic flow direction. The developed vehicles density detection region is shown in Figure 4.

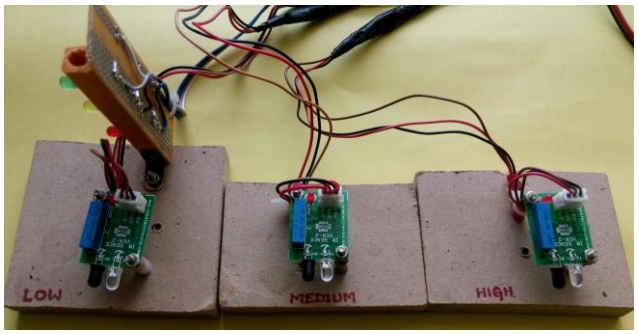

Fig. 4 Developed vehicles density detection region

Since the proposed work is an automated and microcontroller based application, program is developed in Assembly language using 8051 instructions to fulfill all the conditions discussed earlier in the complete functional flow diagram. The reason for selecting 89C51 microcontroller for this work is its built-in feature of 32 I/O lines of 4 ports and ROM, in which the lower port lines P0.0 – P0.2 of port 0, P3.1 – P3.3, P3.4 – P3.6 of port 3 and P2.0 – P2.2 of port 2 are connected to the traffic signal LEDs of West, North, East and South respectively. The IR transceivers output lines are connected with P0.4 - P0.6 and are allocated sequentially as Low, Medium and High. Similarly, port 1 is dedicated to the data lines of LCD display and P2.5 - P2.7 are for control signals of LCD. The developed program is embedded on the 89C51 microcontroller and the performance of the timer according to the density level received from IR array is experimented. As far as system's timer is concerned, the timer values are loaded appropriately as programmed for various density levels and hence the timer responds as expected.

One of the important features of this work is to minimize the speed of the vehicle which enters between the live Low and High region when the signal is at Amber or the signal transition from Amber to Red. This can be achieved with the help 100 KHz RF Transceiver modules. The module which is available at any of the directions acts as Transmitter and is enabled only when the above said condition arises regardless of the presence of incoming vehicles. Similarly, for the same frequency an RF receiver module is fixed in each vehicle through which on receipt the signal from RF transmitter control action will take place in reducing the speed of the vehicle. Based on this concept, schematic speed control circuit is designed and the same is shown in Figure 5.

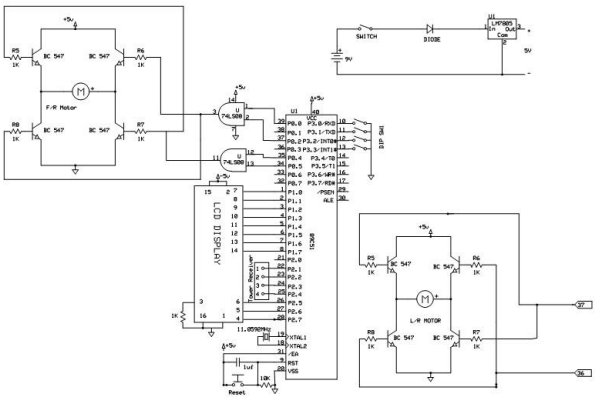

Fig. 5 Schematic diagram of Speed control circuit

The work is designed and developed as a prototype and for study purpose the time N is allocated for three regions in steps of 20 seconds between 20 and 60 seconds. At N-5 seconds the signal gets switched from Green to Amber and at the same time the controller enables the RF Transmitter and keeps ON for the remaining time. The working of timers timing and switching of RF module is tested. The system's response is satisfactory and as expected. The developed prototype vehicle with RF module is shown in Figure 6.

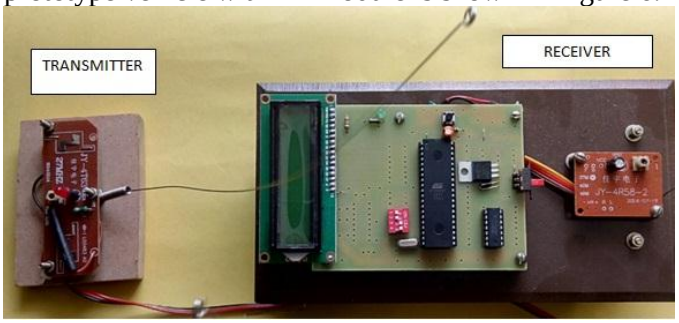

Fig. 6 Developed prototype vehicle with RF module

The complete integrated prototype module is developed for only one direction with one set of density regions, RF Transmitter and a vehicle with RF receiver modules and the remaining directions are provided with traffic signals alone. During experimentation, the behavior of the system is inferred such as proposed switching sequences according to the density level, RF module communications and speed variations in the vehicle during signal transition and so on. The results obtained for the proposed density levels and RF switching is shown in Figure 7.

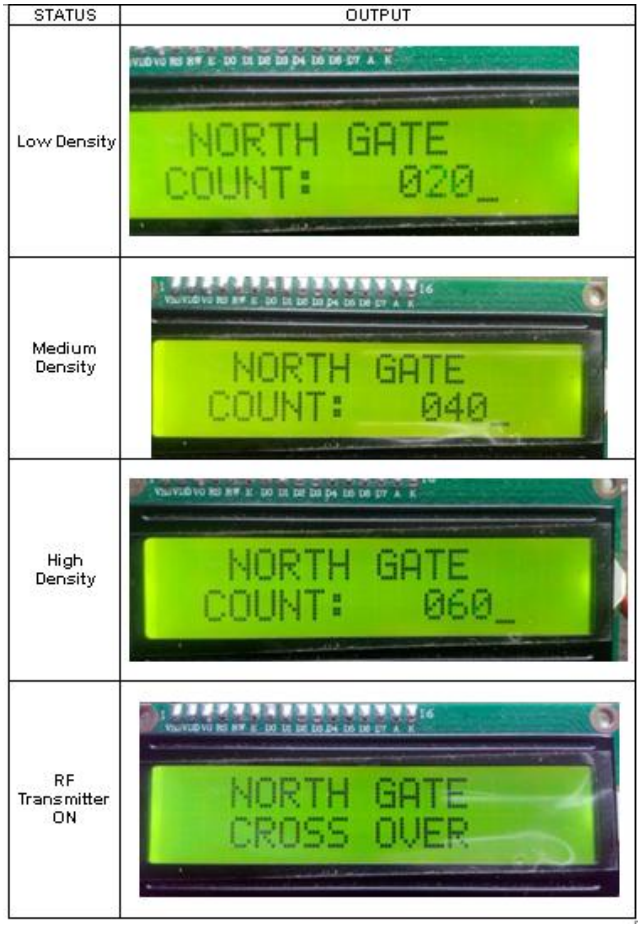

Fig. 7 Obtained results for various density levels

V. CONCLUSION

The density based traffic flow regulator proposed by the authors has been developed and experimented successfully. In the developed module, as programmed the direction is chosen in a cyclic and clock wise manner, i.e., North to East, East to South, South to West and West to North. Also, at N-5 seconds the signal gets switched from Green to Amber and turns ON the respective direction's RF Transmitter for the remaining time. Based on the operation and performance of the developed density based traffic regulator, definitely it is an efficient and intelligent one for 24 x 7 at low cost. The authors are also working on the incorporation of emergency vehicle movements in the developed atmosphere, for which it is proposed to introduce separate frequency of RF transmitter in the vehicle and receiver at junction thereby in the presence of emergency vehicle, the signal can be changed accordingly by giving highest priority to the direction after which the earlier sequence shall be resumed.

REFERENCES

[1] Bazila banu .A, Vidhya. K "Density based traffic signal system" at International conference of Innovations in Engineering and Technology , pp : 2218-2223, 2014.

[2] Khalil yousef. M, Jaman al-karaki.N ,Ali shatnawi.M "Intelligent traffic flow signal system using wireless sensor networks" at Journal of Information Science and Engineering, pp : 753-768,2010.

[3] Manjunath N, Nikschal V.M, Surabhi Mohta, Sindhuja N "Design of an Automated Traffic Control System for Emergency Vehicle Clearance" at Special Issue on International Conference on Advances in Engineering (ICAE), pp : 278-281, 2016.

[4] Roberto Horowitz, Luis Alvarez "Traffic Flow Control in Automated Highway Systems" at California Path Research Report , UCB-ITS-PRR-97-47, 1996.

[5] Sekar. K,Vengadesh. A" Automatic speed control of vehicle in restricted areas using RF and GSM"at International Research Journal of Engineering and Technology, pp : 875-877, 2015.

[6] Syed Azimuddin Inamdar,Faizul Hakeem Khan,Abdul Rahim Makandar,Deepa B Chavan"Automatic vehicle speed reduction system using RF technology"at International Journal of Engineering Research and Applications, pp : 13-16, 2014.

[7] Vijay.S,Rajakumaran.A,Lorate shiny"Vehicle control system with accident prevention by using IR transceiver"at International Journal of Innovative Research in Science,Engineering and Technology, pp : 121-126, 2015.