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Smart Traffic Management System using Advanced Technology

Pramod Gadge[1], Shaikh Uzzair[2], Darshana Manohar[3], Suraj Rangari[4], Uzma Sheikh[5], Aditya Sakhare[6], Hiba Afzal Naaz[7]
[1]*Associate Professor,* [2, 3, 4, 5, 6, 7] *Student, Electrical Engineering, ACET, Nagpur, Maharashtra, India*

Abstract: ***India has seen a rapid rise in its vehicular traffic density over the last few years. Apart from this it has also seen a drastic increase in traffic. Considering the present traffic signals and their management systems, timing of traffic signals are preset and depending upon the area and its average vehicular traffic density, some modifications are done in timings to avoid traffic jams at those signals. This paper focuses on curbing traffic violations as well as designing a system which is efficient at managing vehicular traffic in real-time. The system is implemented using a single controller which helps to remove out the hardware complexities and present an efficient system for practical implementation. RFID technology is used for traffic density measurement and to curb traffic violators from jumping red light, barriers are employed at these signals which will also help to ensure that vehicles are behind zebra Crossings and allow smooth movement for pedestrians while crossing roads. Arduino Mega is used as a controller as it has more number of pins to accommodate all functionalities of the project in a single controller. Barriers at small level are implemented using servo motors to represent an idea of how a traffic signal should work in order to stop people from jumping red lights. The proposed system is an approach to design an efficient system which is capable of managing traffic in real time and also stopping traffic violations.***
Keywords: Traffic density, RFID, Emergency vehicles, Traffic management.

I. INTRODUCTION

As population perpetuates to grow, the increasing authorization on our subsisting conveyance system will become increasingly hard to meet. Roads and highways are unlikely to expand much due to cost and dwindling land supply, so keenly intellective systems such as advanced traffic control will be critical to operating current roadway systems at maximum capacity. Furthermore, poorly timed signals can waste time, fuel. In a street network with poorly timed traffic signals, the fuel consumed by conveyances ceasing and idling accounts for approximately 40 percent of network wide vehicular fuel consumption [4].Traffic signal amendments generally provide the greatest payoff for minimizing surface street congestion when compared with other methods, such as widening roads. Advanced traffic signal control can avail ease congestion and its negative externalities without the cost and environmental impact of road expansion . Traffic control systems such as Pre-timed, Progression Schemes, Actuated, Semi-Actuated Control, Full Actuated Control, Traffic Responsive and Adaptive Control Strategies have intrinsically circumscriptions even today. ***Circumscriptions of current systems***: The SCOOT and SCATS traffic models are built on a vertical queue model and thus cannot consider the effect of downstream link congestion on the signal output. These models operate fairly well as long as the network is not exorbitantly congested. However, they fail to model the effect of downstream congestion on the capacity of upstream intersections during queue spillback. The queuing model is updated from queue quantifications from the field. These systems don't utilize the extra time preserved when one of the left or straight ceases i.e. If one of the two adjacent lanes have ceased the antithesis traffic is still kept waiting even though they can move. Every little move avails in ameliorating traffic flow. The main problem that occurs from these techniques is it cannot keep a check on real time vehicular density and also cannot stop traffic violators from jumping red signals and causing majority of accidents that generally leads to loss of lives of innocent people. Traffic management systems have been time and again developed to provide solution for this problem. The major drawback of these systems was mainly the infrastructural changes required to implement these systems. Another important parameter to be considered is regarding the emergency vehicles that have to get stuck in traffic jams and its only the driving skills of the emergency vehicle drivers that they have adapted over the time to avoid getting stuck in traffic, but these skills sometimes turn risky owing to high speed of vehicle. Pedestrians also don't get a chance to cross roads in high vehicular traffic areas hence a technique to provide time duration for these pedestrians and their safety has been suggested. This paper has been majorly divided into three sections of working as follows:

1) Traffic Signal With barriers under normal traffic condition.
2) Traffic Signal With barriers with traffic density measurement.
3) Traffic Signal with Emergency vehicle System.

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II. LITERATURE REVIEW

The traffic management systems which have been suggested or different techniques for efficient management of traffic are discussed below

A. Traffic Management System Using GSM

This system uses employs IR sensor for traffic density measurement and the side which has the highest traffic density shall get the highest priority for green signal followed by higher to lower traffic density.

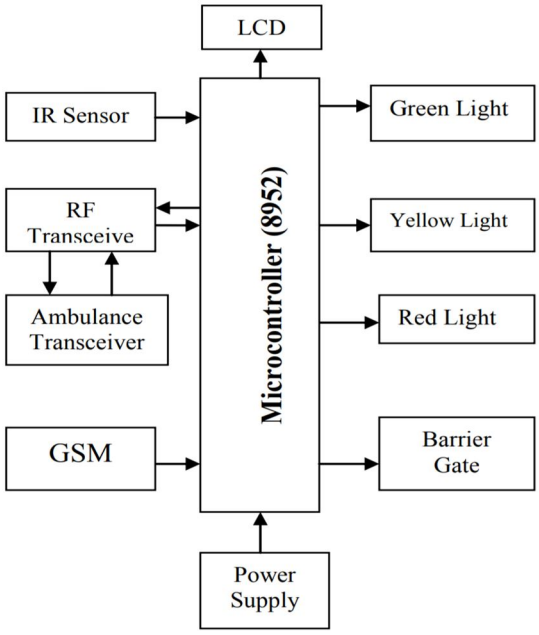

Fig (i): block diagram of traffic management system using GSM

GSM is used to alert the police about traffic violations[1].

B. Advanced Traffic Clearance System Using RF Module

In this paper, system has been implemented using RF module placed in the emergency vehicle system and its receiver placed at the traffic signal connected to its microcontroller. Emergency vehicle systems when reaching near the signal can easily press the RF module transmitter signal and in RF range, it shall be received by the receiver unit placed at the traffic signal. When the RF receiver receives this signal, it shall send signal to microcontroller which in turn will switch on the green lights at that side of the signal thereby making way for it[2].

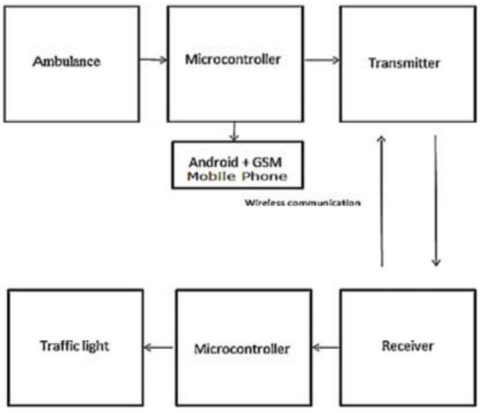

Fig (ii): block diagram of traffic clearance system using RF module

Following problem statement has been analyzed after research:

1) IR sensors cannot be placed on roads on practical basis due to present infrastructural scenario also it is not a feasible option for traffic density measurement.
2) Communication over GSM is not a good option as at small scale database maintenance shall not be a problem but at a city level traffic system, GSM shall fail to maintain records.
3) There should be an arrangement for safety of pedestrians in high vehicular traffic areas.
4) RF modules placed in emergency vehicle systems unnecessarily increase the costs of the system and are not efficient in the long run.

Keeping in mind the above stated points, an efficient traffic management system has been proposed.

III. METHODOLOGY

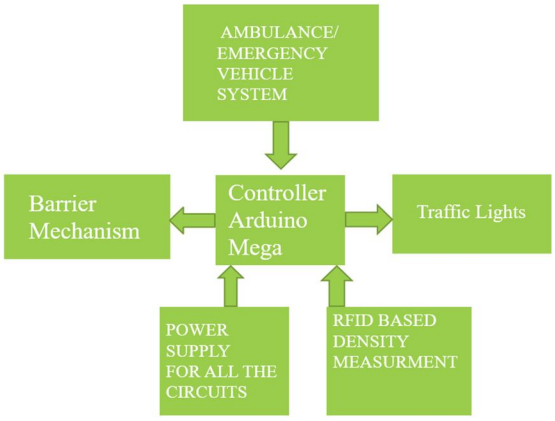

Fig (ii): Block diagram of proposed system

The proposed system can be better understood by analyzing its algorithm. Given below is the algorithm for proposed system.

A. *Algorithm*

1) System turns ON and normal traffic conditions are initialized.
2) Barriers for red lights are turned on.
3) After completion of one full cycle, all the lanes are stopped (red) and a blue signal is given for pedestrians to cross roads.
4) RFID 1 and RFID 2 are checked for threshold value.
5) If threshold value is reached, traffic density of both sides is checked and one with more traffic density shall receive priority.
6) If emergency vehicle is detected, immediately that side will be made green to allow passage of emergency vehicle.
7) The cycle repeats itself till the system remains ON.

The proposed system is a prototype to represent the idea of a smart traffic management system and hence two sides are equipped with RFID readers, one side is dedicated to demonstrate emergency vehicle system. All the four sides have barrier mechanism employed which is represented with a servomotor. Figure below indicates the model of proposed system for better and clear understanding of the project.

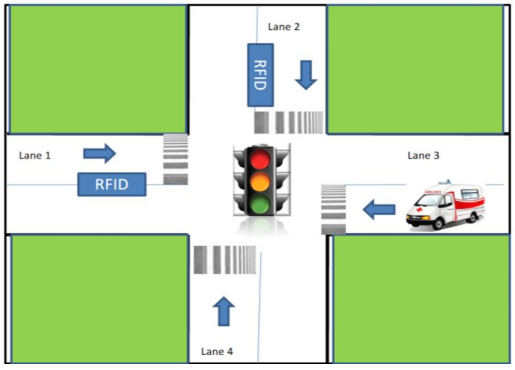

Fig (iv): Basic model design of proposed system

a) Condition 1: When normal traffic conditions are observed.

Traffic Signal lane	Signal Indication	Pedestrian
Lane 1	Green	--
Lane 2	Red	--
Lane 3	Red	--
Lane 4	Red	--

(a)

Traffic Signal lane	Signal Indication	Pedestrian
Lane 1	Red	--
Lane 2	Green	--
Lane 3	Red	--
Lane 4	Red	--

(b)

Traffic Signal lane	Signal Indication	Pedestrian
Lane 1	Red	--
Lane 2	Red	--
Lane 3	Red	--
Lane 4	Green	--

(c)

Traffic Signal lane	Signal Indication	Pedestrian
Lane 1	Red	Blue
Lane 2	Red	Blue
Lane 3	Red	Blue
Lane 4	Red	Blue

(d)

Table (i-a,b,c,d): traffic signal under normal conditions

Yellow Light is not indicated purposely to avoid complexity in understanding the functioning of traffic signal under normal conditions. Lane 1 , Lane 2 , Lane 3 , Lane 4 gets their chance for green signals respectively and then all the signals turn red for preset duration to allow pedestrians to walk. The rotation of signals chance by chance can be changed by programming the controller.

b) Condition2: Traffic Density measurement using RFID

The two RFID readers are compared for density and the one with more density is served first and that side's signal turns green. The two RFID comparisons are represented and results are shown in the above table

RFID 1 > RFID 2

Traffic Signal lane	Signal Indication	Pedestrian
Lane 1	Green	--
Lane 2	Red	--
Lane 3	Red	--
Lane 4	Red	--

RFID 2 > RFID 1

Traffic Signal lane	Signal Indication	Pedestrian
Lane 1	Red	--
Lane 2	Green	--
Lane 3	Red	--
Lane 4	Red	--

Table (ii): traffic signal after comparison

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c) Condition 3: Emergency vehicle system

When an emergency vehicle passes, its RFID tag code is saved in the database and hence as soon as it is detected, the lane from which the vehicle is coming gets green, in our case its lane 3 as to give demonstration of our prototype.

Traffic Signal lane	Signal Indication	Pedestrian
Lane 1	Red	--
Lane 2	Red	--
Lane 3	Green	--
Lane 4	Red	--

Table (iii): traffic signal after emergency vehicle detection

IV. HARDWARE

1) *Arduino MEGA (Controller):* The controller is used to coordinate the three functionalities of this project as there is a requirement of more no. of pins. It is programmed using Arduino IDE. The components are connected to it and it is programmed for its functionality accordingly.
2) *RFID (EM-18Module):* RFID tags are installed on the vehicles and reader shall be placed on the footpaths which shall help to monitor the traffic density as well as detect emergency vehicles such as ambulance. Emergency vehicles shall have the tags whose ID is saved in the database.
3) *Traffic LED Lights:* Four sides will have four lights each, for this a special module is designed on PCB. The three lights represent the conventional modes but the fourth light indicates blue color that has been proposed for pedestrians.
4) *Servo Motor (sg90):* The barriers are represented using servomotor shaft movements. The movement at an angle of 90 degree is chosen to best fit the demonstration purpose.

A. Schematic Diagram

The schematic diagram is drawn using proteus software.

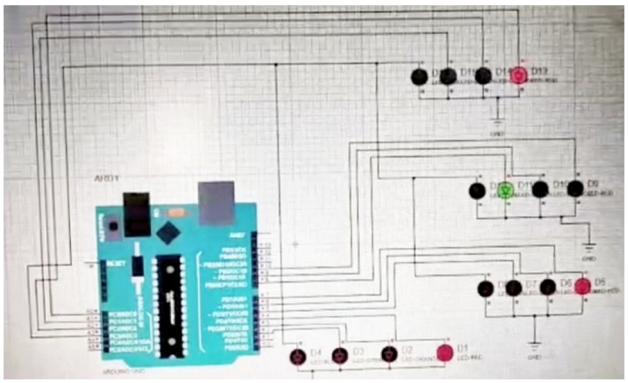

Fig (v): Schematic diagram of proposed system

Figure (v) above shows the schematic connection diagram of the project.

V. RESULT AND CONCLUSION

The proposed system is a novel approach towards implementation of smart traffic management system which is capable of managing real time traffic conditions and does not need much infrastructural change as the fastags are already compulsory for vehicles nowadays hence users won't have to buy extra circuit or any hardware module rather it is using the existing tags which users have already purchased. Another important feature of emergency vehicles is considered which also utilizes special tags that can be provided for emergency vehicles. Pedestrian's safety is considered and one more light with conventional traffic signal has been proposed which can be of blue color. It shall ensure that when pedestrians walk there is no vehicular traffic ensuring smooth operations of the system.

VI. ACKNOWLEDGMENTS

We thank our Guide Prof Pramod Gadge Sir for his guidance at all stages of this project and for all the support in critically analyzing the parameters of the project to ensure best results from the project

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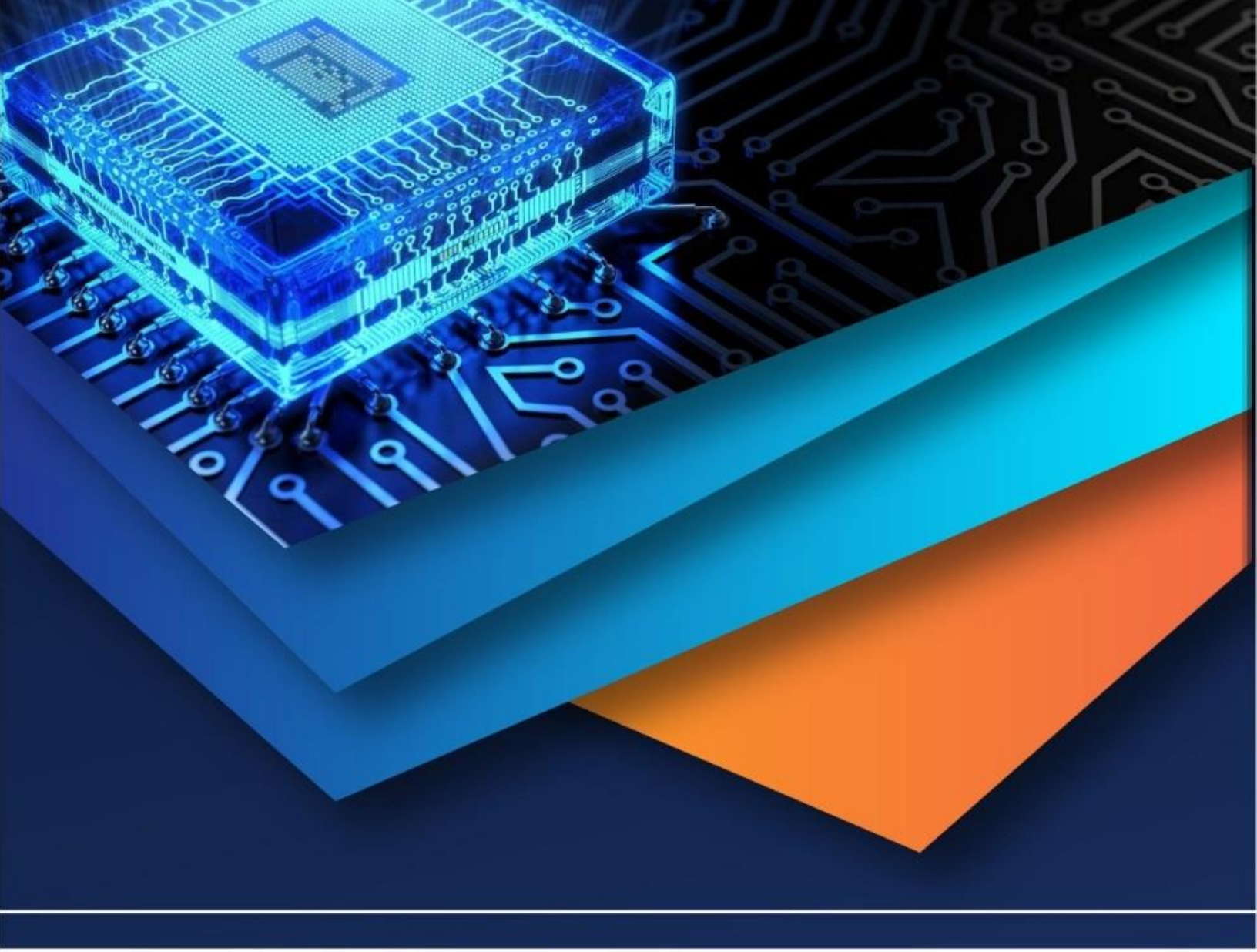

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