ISSN 2349-6193
Impact Factor (PIF): 2.243

IJESMR

International Journal OF Engineering Sciences & Management Research

INTELLIGENT TRAFFIC LIGHT CONTROL USING WIRELESS SENSOR NETWORKS WITH PRIORITIZE EMERGENCY VEHICLES

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Keywords: Traffic congestion, Emergency vehicles, WSN, Sensor.

ABSTRACT

Vehicular traffic is the major problems in the fast developing countries. Major increase in number of vehicles in cities leads to heavy traffic congestion. Most of the traffic signals are based on fixed time allotments. Higher traffic density at one side requires longer green signal as compared to the less traffic density at another side. The major disadvantage of fixed allotments at signal may cause higher traffic congestion at peak hours. To avoid the disadvantage of fixed time allotment, we proposed a new method to control traffic in an efficient manner. This method has make use of Wireless Sensor Networks (WSN) at the road side junction and assigns time period to glow the respective lights. Based on the traffic at the junctions the time slot also varies. The sensor placed at the junctions will continuously monitor the vehicles and generate messages to avoid congestions. We also proposed to give importance to the Emergency vehicles such as ambulance, fire and VIP vehicles by giving special numbers to them. This technology is mainly designed to avoid traffic congestion at junctions and gives more priority to the emergency vehicles. These techniques are dynamically adapted for both single and multiple intersections.

INTRODUCTION

One of a critical problem in the major countries are continuous increase in the congestion level at rush hours leads to higher traffic density and is becoming a major problem for the transportation specialists and the decision makers. In today's world Intelligent Traffic System (ITS) has lot of limitations on the fixed timing allotment system, because these systems are not on real time basis. Due to the fixed timings of red, green and orange lights, the waiting time of the people is more and fuel also wasted. Since they followed fixed time slot, there is a possibility of red signal where a large number of vehicles and green signal where there are no vehicles. The existing methods for traffic management, control and surveillance are not efficient in terms of cost, performance, support and maintenance.

In this paper, we analyzed a method that will efficiently utilize the traffic congestion and manages the traffic lights. We also give importance for the emergency vehicles by giving priority for them. These techniques make use of sensors at the junctions and analyze the traffic at each road along with the signals. Then it assigns the time period to glow the respective lights. According to traffic density at each junction the time slot varies. Based on the total traffic at the each junctions the lights will be automatically decided. Thus, it prevents the traffic congestion and also it optimizes the traffic [8].

The major problems occur due to traffic congestion are:

Heavy traffic jam will waste time as well as fuel. At the main junction it happens when people have emergency such as office hours, school and college timings, etc. At certain junctions there would be no traffic but still people has to wait, since the traffic light remains red for longer period of time. People have to wait until the light turns into green. Sometimes emergency vehicles such as ambulance, fire and VIP vehicles are stuck into traffic due to congestion. The present traffic system does not provide congested road traffic information and also does not provide alternate roads, when roads are congested in traffic.

In the proposed work, two junctions are to be discussed and bring into focus along with the use of the wireless sensor networks. Due to heavy traffic jam emergency vehicles face hardship when they pass from junctions. On the basis of WSN, traffic control systems of two junctions will able to minimizes the traffic and thus assigns the right time for red and green lights to glow, so that the emergency vehicles can pass easily. A WSN is used as a tool instrument and control the traffic signals.

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LITERATURE REVIEW

K. Vidhya and et al. [1] proposed a density based traffic signal system which changes the signal timings automatically by sensing the traffic density at the junctions. In major cities, the traffic signal timing allotted are fixed. The research mainly aims to control the traffic signal by capturing the image and then converting them into the grayscale image and then to the threshold image. The Contour image helps to count the number of vehicles present in the junction. The output screen shows the numbers of vehicles present at the junction and the green signal will glow based on the traffic density. They analyzed the image sequence and then estimate traffic congestion and finally predict the traffic light timings. Raspberry pi microcontroller is used to sense the traffic density and provides the signal timings.

A. Ms Promila Sinhmar [2] proposed a intelligent traffic light and density control using IR sensors and microcontroller which optimizes the traffic light control using microcontroller. The microcontroller used in this research is 89451RD2 which is MCS51 family based. IR transmitter and IR receiver is placed on either side of the road. When a vehicle is passed on a road between IR transmitter and IR receiver, the IR system automatically gets activated and counts the number of vehicles present and store in its memory. Based on the vehicles count the microcontroller takes decision for traffic signal timings. In their research they proposed, first to take input or image from the vehicles or object. Second is to process the given input by microcontroller to the computer and then finally it displays the traffic light control using closed loop system.

Their future work is, it can be used to inform the people about various traffic conditions at different places and also transferring the data between the microcontroller and computer using telephone network and the data cell activated through sim.

Rashid Hussain and et al. [3] proposed WSN applications: automated intelligent traffic control system using sensors. This research is proposed to sense the traffic availability in the circle or junction and then regulate the traffic in a systematic manner. Most of the researches comprises of image processing technique which is more expensive and complex. This proposed system consists of three components namely, sensor nodes or motes, power source and microcontroller. This system is used to sense the vehicles using wireless sensor networks and a microcontroller based algorithm is used for traffic management. The wireless sensor nodes are placed at the junction to make it easy at high density of vehicles.

Amnesh Goel and et al. [4] proposed intelligent traffic light system to prioritized emergency purpose vehicles based on wireless sensor network. In their research they propose an adaptive traffic intersection system based on Wireless Sensor Network where the traffic light of one intersection an communicate with the traffic light of the next neighboring intersections and traffic clearance will be prioritized for special vehicles with the help of sensors. Their proposed method is used to minimize the average waiting time, then maximizes the average number of vehicles passing through intersection and finally minimizes the accidents. Their research is to give a clear way to emergency vehicles without stopping on signals to reach the destination in a effective way.

Khalil M. Yousef and et al. [5] proposed an intelligent traffic light flow control system using wireless sensors networks. This paper is mainly focusing on managing the traffic light control efficiently and utilizes the system design. An adaptive traffic control system using wireless sensor networks are dynamically used for both single and multiple intersection to control the traffic conditions. Their research contains Traffic System Communication Algorithm (TSCA) and the Traffic signals Time Manipulation Algorithm (TSTMA), both the algorithms are used for efficient traffic control by the dynamic changes in the traffic signals. In single intersection, traffic congestion can be solved by calculating average waiting time and average queue length whereas an efficient traffic flow control globally on multiple intersection. Their future work can simulate the human behaviors and package the entire system using fpga technology. And also, different types of intersection and different types of crossing directions also considered.

Shruthi K. R. and et al. [6] proposed an priority based traffic lights controller using wireless sensor networks. This paper is mainly focusing on managing the traffic light control efficiently and utilizes the system design. An adaptive traffic control system using wireless sensor networks are dynamically used for both single and multiple intersection to control the traffic conditions. This research mainly designed to control the traffic over multiple intersections. This proposed system focus on emergency vehicles.

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DESIGN OF TRAFFIC WIRELESS SENSOR NETWORK

We are placing sensors at roadside at every 500m distance. So that, we can able to sense all the vehicles passing through the junction.

We have designed and implemented a complete functional WSN and used it to validate the proposed algorithm. Consider the two junctions namely, J1 and J2 as shown in the figure 1. Wireless sensors such as S1, S2, and S3 are placed 500m away from the junctions.

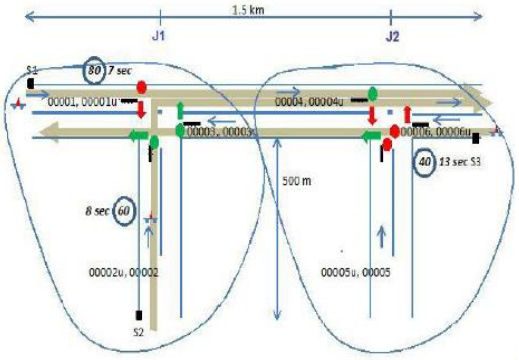

Figure 1: Proposed scenario of two junctions

Now, we are considering three emergency vehicles such as ambulance, fire brigade and VIP vehicles, coming from three different directions at the same time with different speed. Based on the speed of three vehicles detected by the sensors, firstly it minimizes the traffic flow their routes so that they can able to pass by their minimum speed. So that, collision may be avoided.

Now consider an ambulance is coming from the left side of junction J1 having its route defined straight ahead and it will pass the roadways W1 and W7 respectively. Next, we consider a VIP vehicle is coming towards junction J1 and it will pass through W3 and W7 roadways. Finally, we consider a fire brigade vehicle is coming from the right side of the junction J2 and it will pass through W1 and W5 roadways respectively. Each of the wireless sensors has been placed at 500m away from the junctions. The total distance between the sensor S1 and S3 is 1.5km. The expected time of the emergency vehicle is calculated on the following formula:

Distance = Velocity / Time
(or)
Velocity = Distance / Time

Sensors are to be placed on the traffic lights. Sensors sense the Radio Frequency (RF) signal emitted by the emergency vehicles. After detecting the emergency vehicles, the traffic light control changes depending upon the priority given to the emergency vehicles. As soon as the emergency vehicles pass through the junction, the traffic signal automatically changes to its original position if there is no emergency vehicle in the queue.

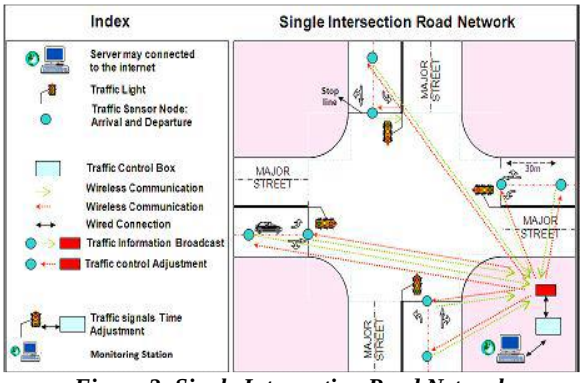

Figure 2: Single Intersection Road Network

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The architecture for single traffic signal is follows:

- There are four paths marked it as N(North), S(South), E(East) and W(West) leading to the road intersection. Each path has three lanes in the incoming direction, which are turn-right(R), turn-left(L) and go-forward(F). so every passing vehicle can have a path P of {N, S, E, W} and a direction D of {R, L, F}.
- The sensors are to be placed at the traffic lights. For a single road intersection at least 4 sensors are needed.

TRAFFIC CONTROL ALGORITHM FOR SINGLE INTERSECTION

In this section, we proposed an algorithm for single intersection. The data at junction J1 contains sensors, traffic light, traffic flow and roadways. Here in the table G represents green signal and R represents red signals. Our main aim is to focus on the green light to move the traffic as soon as possible in emergency situations. This method is very simple and inexpensive.

Table 1: Signal Prediction

Junctions Sensors Traffic Flow	J1					
	S1 100		S2 60		S3 50	
Roadways	W1	W2	W3	W4	W5	W6
Traffic Light Status G = Green Y = Yellow R = Red	G	G	R	G	R	R
	G	G	R	G	R	R
	R	R	G	G	G	G
	R	R	G	G	G	G

ALGORITHM:

1. Collects the GPS & map information
2. Check whether neighbor vehicle is found
   a. *If* yes *then*
      *i. S*hare the speed and direction movement
   b. If no *then*
      i. Ignore
3. Check whether Emergency vehicles
   a. *If* yes *then*
      i. Update to the base station
      ii. Inform to the traffic control adjustment
   b. *If* no emergency *then*
      i. ignore
4. *If* more than an emergency vehicles arrive at different directions *then*
   a. Calculate their speed and distance
      i. *If* no possibility of collision *then*
         1. open the signals for vehicles according to their arrival
      ii. *Else*
         1. Collect their priority number from vehicles
         2. Open the signals as the priority.
5. *If* there is a traffic congestion *then*
   a. Identify alternate route from the given route map
   b. Send signals to emergency vehicle for diversion.

Algorithm 1: Traffic Wireless Sensor Network Algorithm.

- The vehicles transmit the RF signal and the sensor on traffic signal detects the signal and communicates wirelessly with traffic lights controller.
- Traffic lights controller senses the signal and receives request from all sensors.

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- It checks priority and changes the traffic lights accordingly.
- The system resumes back to its original position after the emergency vehicle passes.

Figure 3: Priority Based Signaling

IMPLEMENTATION

The proposed method is implemented in NS2, simulations results show the efficiency of solving the traffic congestion using sensors. Based on the speed, sensors will communicate wirelessly with the traffic control system of the two junctions. The result clearly says that the highest priority is given to the emergency vehicles such as ambulance, fire brigade and VIP vehicles.

CONCLUSION AND FUTURE SCOPE

In this paper we proposed a wireless sensor based technology for traffic light control. We conclude that it gives more powerful solution than the existing system. The traffic light signals are blinked according to the density of traffic present at the junctions. This system also manages the traffic when emergency vehicles come. This method also prioritizes the emergency vehicles using special numbers in the junctions.

This paper can be extended further by using some other applications for automatic gate opening. In future, it can be extended to find out the shortest path for the emergency vehicles to reach their destination.

REFERENCES

1. K. Vidhya, A. Bazila Banu "*Density Based Traffic Signal System*" International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Mar. 2013.
2. A. Promila Sinhmar, Zakopur "*Intelligent Traffic light And Density Control Using IR Sensors And Microcontroller*" International Journal of Advanced Technology & Engineering Research, volume 2, Mar. 2013.
3. Rashid Hussain, Sandhya Sharma, Vinita Sharma, Sandhya Sharma "*WSN Applications: Automated Intelligent Traffic Control Using Sensors*" International Journal of Soft Computing and Engineering, ISSN: 2231-2307, Volume-3, July 2013.
4. Amnesh Goel, Sukanya Ray, Nidhi Chandra "*Intelligent Traffic Light System To Prioritized Emergency Purpose Vehicles Based On Wireless Sensor Network*", International Journal of Computer Applications, Volume 40- No.12, Feb. 2012.
5. Khalil M. Yousef, Jamal N.Al-Karaki, Ali M. Shatnawi "*Intelligent Traffic Light Flow Control System Using Wireless Sensors Networks*", Journal of Information Science and Engineering, Sep. 2009.
6. Shruthi.k.R, Vinodha .K "*Priority Based Traffic Lights Controller Using Wireless Sensor Networks*", International Journal of Electronics Signals and Systems, ISSN: 2231 - 5969, Vol-1 Iss-4, 2012.
7. Minal K. Avzekar, Amruta Moon "*Adaptive Traffic Signal Control With VANET*", International Journal of Scientific Engineering and Research, ISSN: 2347-3878, Volume 2 Issue 3, Mar. 2014.
8. Vignesh. Viswanathan, Vigneshwar. Santhanam "*Intelligent Traffic Signal Control Using Wireless Sensor Networks*", 2nd International Conference on Advance in Electrical and Electronics Engineering, Mar. 2013.
9. A.D.Jadhav, Bhor Madhuri T., Thakre Ketan L., "*Intelligent Traffic Light Control System*", Proceedings of 4th International Conference, Mar. 2014.
10. T. Sujitha, S. Punitha Devi "*Intelligent Transportation System For Vehicular Ad-Hoc Networks*", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Mar. 2014.

ISSN 2349-6193
Impact Factor (PIF): 2.243

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