Intelligent Traffic Lights Based on RFID

*Harpal Singh, **Krishan Kumar, ***Harbans Kaur
*Guru Kashi University/ Computer Application Dept, Talwandi Sabo, India
Email: harpalghuman11@gmail.com
**Guru Kashi University/ Computer Application Dept, Talwandi Sabo, India
Email: mandeep.13742@lpu.co.in
***Miri Piri Khalsa College/ Computer Application Dept, Bhadour, India
Email: mandeep.13742@lpu.co.in

Abstract

Traffic management is the critical issue of the road. Traffic lights play an important role in the traffic management. The existing traffic lights follow the predetermined sequence. So these lights are called static traffic lights. These traffic lights are not capable to count the number of vehicles and the priority of the vehicles on intersection point. As a result some vehicles have to wait even there is no traffic on the other side. The vehicles like Ambulance and Fire Brigade are also stuck in traffic and waste their valuable time. The proposed system provides quality of service to Emergency vehicles and improves the accuracy of Automatic Traffic Light Violation Detection system as well as helps to trace out the stolen vehicles using RFID.

Index Terms- Intelligent Traffic light controller, round robin, RFID

I. Introduction

With the growth of the urbanization, industrialization and population, there has been a tremendous growth in the traffic.

With growth in traffic, there is occurrence of bundle of problems too; these problems include traffic jams, accidents and traffic rule violation at the heavy traffic signals. This in turn has an adverse effect on the economy of the country as well as the loss of lives. The expected increase of cars and SUVs from 2005 to 2035 is 13 times (35.8 million to 236.4 million vehicles), while two wheelers are expected to increase about 6.6 times (35.8 million to 236.4 million vehicles) [1]. So problem given above will become worst in the future.

Traffic lights play an important role in traffic management. Traffic lights are the signaling devices that are placed on the intersection points and used to control the flow of traffic on the road. In 1868, the traffic lights only installed in London and today these have installed in most cities around the world [2]. Most of the traffic lights around the world follow a predetermined timing circuit. Sometime the vehicles on the red light side have to wait for green signal even though there is little or no traffic. It results in the loss of valuable time.

Traffic control at intersections is a matter of concern in large cities. Several attempts have been made to make traffic light's sequence dynamic so that these traffic lights operate according to the current volume of the traffic. Most of them use the sensor to calculate current volume of traffic but this approach has the limitation that these techniques based on counting of the vehicles and treats a emergency vehicles as the ordinary vehicles means no priority to ambulance, fire brigade or V.I.P vehicles. As a result, emergency vehicles stuck in traffic signal and waste their valuable time. Another limitation of this approach is that sensor based system needs the line of sight path between the sensor & vehicles which results in low performance.

The problem of traffic light control can be solved by RFID based system. With this system, we can consider the priority of different type of vehicles and also consider the density of traffic on the roads by installing RF reader on the road intersections. Radio frequency identification is a technique that uses the radio waves to identify the object uniquely. RFID is a technique that is widely used in the various application areas like medical science, commerce, security, Electronic toll collection system, access control etc. There are three main components of RFID: RFID tag, RF Reader and Database. Various types of tags are available but we can mainly divide them into two categories: passive tags and active tags. The passive tags don't contain any internal power source. There are three parts of the tag: antenna, semiconductor chip and some form of encapsulation. The life of the passive tag is very long. The reader sends electromagnetic waves that produce current in the tag's antenna. In response antenna reflects the information stored in it. The active tags contain a battery as an internal power source used to operate microchip's circuitry and to broadcast the information to the reader. The range and cost of these tags is more as compare to passive tags [5][6]. We have three kinds of tags which work on the three different frequency ranges: low – frequency, high-frequency and ultra high frequency. The Low frequency tags works on frequency lies between 30 ~ 300 KHZ and High Frequency and Ultra High Frequency Tag works on the frequency range lie 3 ~ 30 MHZ and 300 ~ 3 GHZ respectively [6].

The paper is organized as follows: Related Work, Proposed Work and Conclusion.

II. RELATED WORK

The roads intersection is a bottleneck point in the urban traffic network and it is very critical node. Traffic may accumulate quickly and traffic jam can occur quickly in case the traffic

control system is not efficient to properly manage the vehicles queues in fast and smart manner. The work in [11] proposed a smart traffic control system based on the wireless sensor network and an alerting system for red light crossing scenario to alert the drivers on other sides to save their lives. This technique is based on the queue length of the vehicles on the traffic lights. They also represent the simulation of 4 models which are used in the different parts of the world and shows competing results in the terms of waiting time and number of vehicles not served first time. The work in [10] proposed an approach to integrate Wireless Sensor Network (WSN) in the RFID Reader to implement bus management system where motion sensors are used to send command to the RFID reader to enter in the read when it detects the RFID tag movement around it and then RFID Reader reads the contents of RFID tag and pass this information to host application via IEEE 802.15.4/Zigbee standard, that reduces the cost and time by eliminating the wired installation of cable . Here they also compare Bluetooth and Zigbee technique for wireless communication.

III. PURPOSED WORK

Under the proposed work, each intersection contains 8 RFID readers. The road is divided into two lanes. Each lane has its RFID reader to track the vehicles passing through it. Each intersection point has its own database to store the information regarding the vehicles that passed from it with timestamp and traffic light. Every vehicle has a RFID enabled device that stores a vehicle identification number (VIN). Every vehicle has its unique VIN number that provides the information regarding the priority of the vehicle and type of the vehicle. With the help of VIN we can uniquely identify the vehicle & its owner.

Vehicle Identification Number: In the proposed work RFID, tag will store a Vehicle Identification Number. This number is divided into 3 parts: First part represent the priority of the vehicles. Next part represents the type of vehicle and next digits represent the vehicle number.

Priority: In the proposed work, different types of vehicles have the different priorities. The total vehicles are divided into 4 categories: First system category includes Ambulance, Fire Brigade vehicles and V.I.P vehicles. These vehicles have the highest priority. The second category includes the buses and school & college buses. These buses need to reach their destination on time so these vehicles also need a fast service. Third category includes the car, motor cycles and scooters and fourth category include the Heavy vehicles. Day time priority

of 3rd category is high as compare to 4th category but during night hours the priority of the heavy vehicles high.

Each intersection on the road has 4 traffic lights as shown in the figure 1. Each lane has its own RFID reader that stores the vehicles passing through it with time stamp. On the basis of the time stamp, we find the violators. For this purpose we store the duration of the green light. So the vehicles coming on the corresponding light are allowed to move in any direction. During this time reader corresponding to red light stores the vehicles passing through the lane.

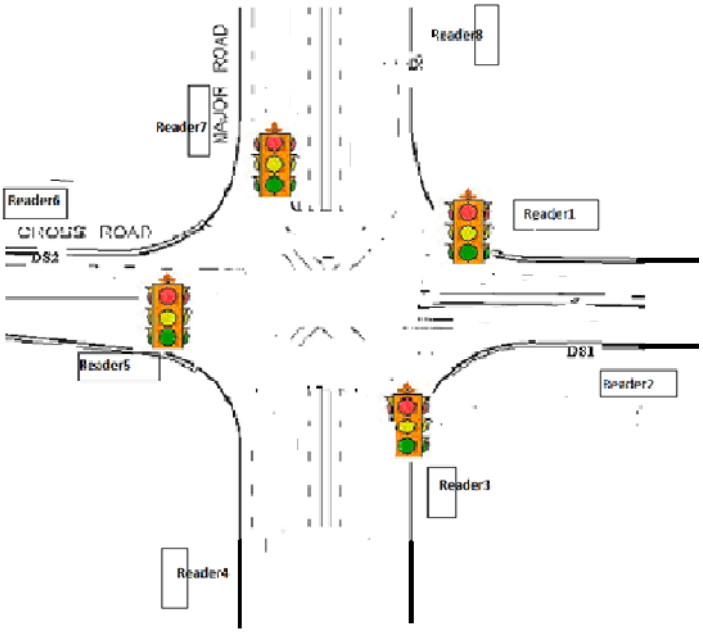


Figure 1: Structure of the Intersection & placement of the reader

Intelligent Traffic Light Controller: Each city has multiple intersections as shown in the figure 2. Two lights are called linked Lights that are placed on opposite sides of the road that join two intersections. The RFID reader stores the records of all the vehicles that passed through the road. The Traffic light controller follows the same round robin sequence of the lights. But if an Emergency vehicle is detected at any traffic light then controller leave the round robin schedule and generate the green signal for the ambulance. The other task of the controller is to calculate the time of green signal that is based on the number of vehicle. To solve the problem of Starvation a time limit is defined. If this limit exceeds then that light gets its turn.

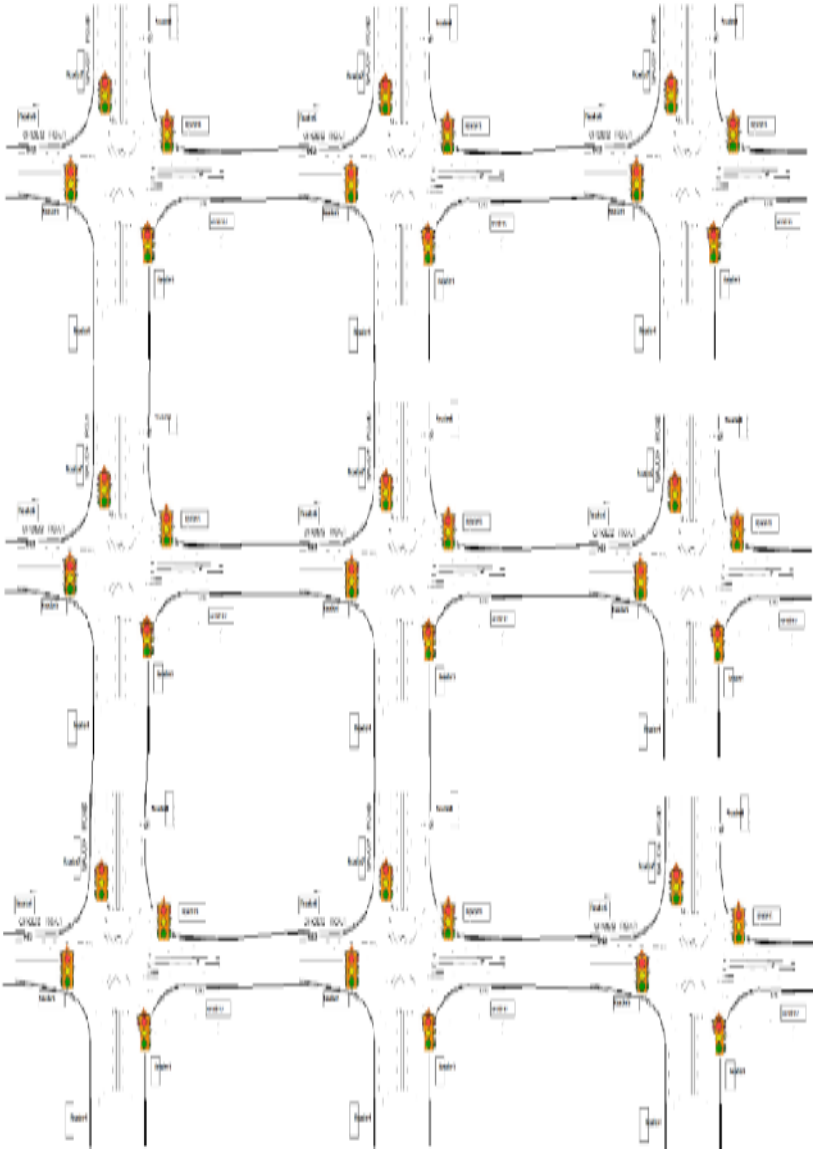


Figure 2: Structure of the city roads

Pseudo code for traffic light control: The following given pseudo code helps to generate an efficient algorithm to control the sequence of the traffic light according the parameters discussed above.

While (true)

1. Store all lights in Queue

2. Sense the vehicles on different lights continuously

3. If a high priority vehicle is detected then

a. Send an emergency signal to center Traffic light controller
b. Find the road corresponding to the reader that detect a high priority vehicle
c. Set the corresponding traffic light Green

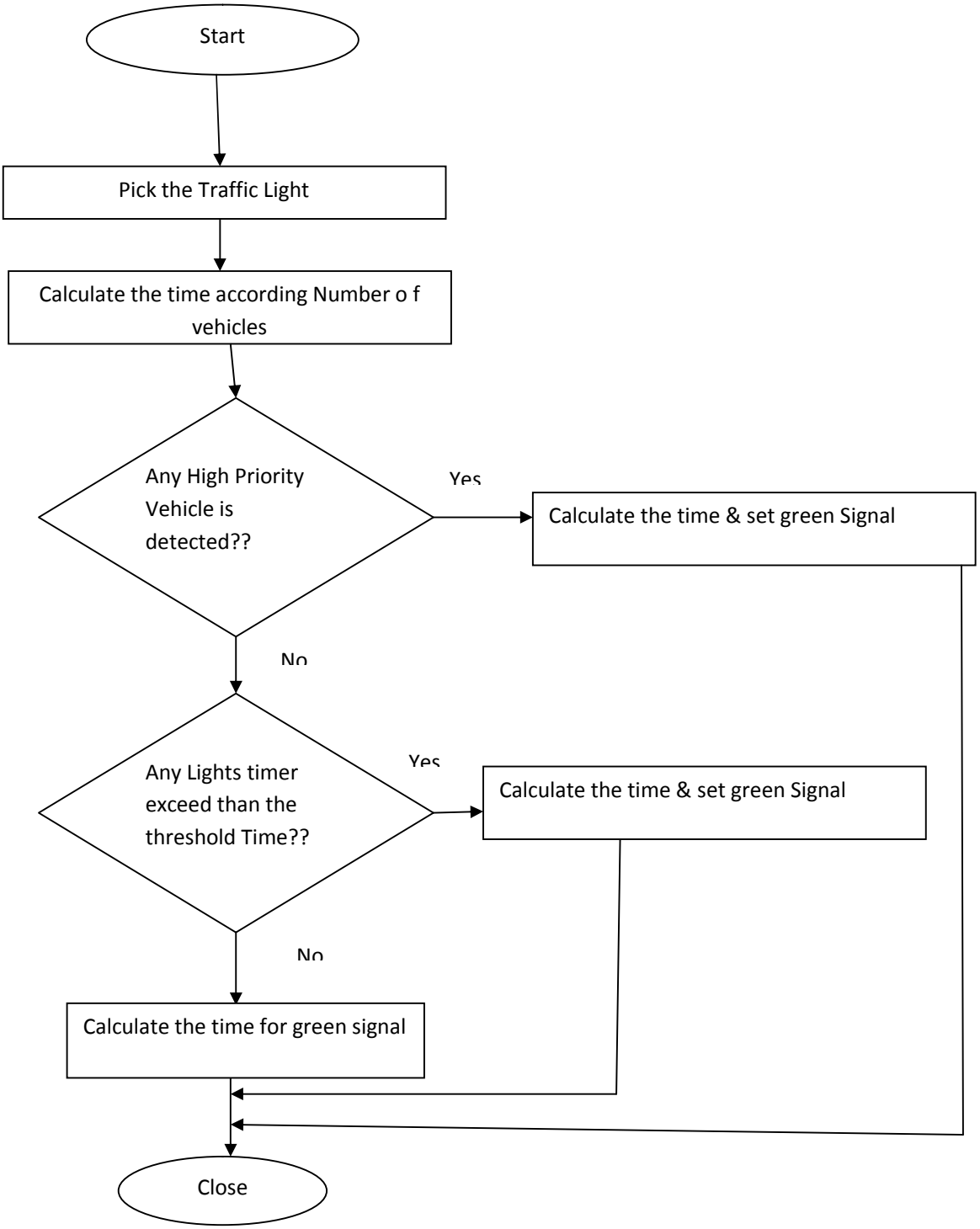
4. Else

5. For i=1 to 4
    a. At decision point dp Pick the traffic light Queue[i]
    a. At traffic i Count the number of vehicles & check type of vehicle
    b. If Emergency vehicle found then
        1. Go to step 3
    c. Else follow steps d to f
    d. Find the priority of the different vehicle at traffic light i
    e. Calculate the total sum according to Number of vehicle
    f. On the basis of sum calculate the time for green signal
    g. If any light doesn't get it term within the threshold time then
        1. Give the turn to that light

6. End Loop

7. End

The flow chart given below represents the flow of the algorithm. In which after receiving the message from linked lights controller consider the factors like traffic density of the road, priority of the vehicles and queue length and starvation factor to decide the term of the light to display green signal. The flow chart given below not only works according to the number of vehicles near the traffic light but also solve the problem of starvation that can be arisen. Here the basic purpose of the algorithm is to calculate the green time duration and also provide the quality of the service to the Emergency vehicles like ambulance, Fire brigadeand VIP vehicles so that they can reach at their destination as early as possible and reduce the time wasted at the Red Light.


Start
Pick the Traffic Light
Calculate the time according Number o f vehicles
Any High Priority Vehicle is detected??
Yes
Calculate the time & set green Signal
No
Any Lights timer exceed than the threshold Time??
Yes
Calculate the time & set green Signal
No
Calculate the time for green signal
Close

IV CONCLUSION

Although previous approach represents efficient techniques to control the traffic light sequence but these are not to provide the QoS to Special Vehicle. The proposed work considers not only the priority of the vehicles but also the density of the vehicles on the road and controls the traffic light sequence efficiently and more accurately and the accuracy of the RFID is more than Camera's so it also improves the performance of traffic light Violation Detection System.

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