Study of Automatic Traffic Management at Traffic Signal in Central Road Research Institute

1. INTRODUCTION

- In the metropolitan cities of India, traffic congestion is a major problem. Traffic congestion is caused when the demand exceeds the available road capacity. This is known as saturation
- Individual incidents such as accidents or sudden car braking in a smooth flow of heavy traffic have rippling effects and cause traffic jams.
- In a country like India, there is an annual loss of Rs 60,000 crores due to congestion (including fuel wastage). Congestion in India has also led to slow speeds of freight vehicles and increased waiting time at checkpoints and toll plazas.
- The average speed of vehicles on key corridors like Mumbai-Chennai, and Delhi-Chennai is less than 20kmph, while it is mere 21.35kmph on the Delhi-Mumbai stretch. Per the transport corporation of India and IIM, India's freight volume is increasing annually at a rate of 9.08% and that of vehicles at 10.76%, but that of the road is only by 4.01%. This has resulted in reduced road space in accordance with the number of total vehicles. The average fuel mileage in India is only 3.96kmpl. The major reason for this is traffic congestion.
- The framework that is currently in the application, uses a predetermined time duration for the traffic signal and any changes require human intervention and manual traffic control by the designated authorities.
- Hence there is a need to manage traffic in a smart way as the management of traffic in a conventional way such as the signalling system is not having a major effect in curbing congestion of vehicular traffic.

2. Our Approach to Solve the problem

- Our approach is to decide the signal time as a function of the number of cars crossing the signal. If there are a greater number of cars then the signal time will be increased to clear congestion.

2.1 Background

A Radio Frequency Identification (RFID) system consists of
RFID controller and RFID tag.

1) RFID Controller:

The RFID controller consists of an RFID interrogator. This interrogator is used for communication with the RFID tag. The RFID controller then gets the signals/data received by the interrogator. Messaging interference is used to send commands and data messages from the controller components. The controller core is present inside the RFID controller. The controller core listens to the interrogators and depending upon the configuration; the controller core can perform read/write operations upon the RFID tag or can do both listening and performing operations. The RFID controller can have a serial interface through which external GSM/GPRS devices can be interfaced with it to make a dual radio device.

2) RFID Tag:

RFID tags are wireless devices which make use of radiofrequency electromagnetic fields to transfer data, which is used for identifying and tracking objects. RFID tags are of two types: Active and Passive. Active RFID has a battery installed, which the passive RFID doesn't have. Passive RFID has to depend on external sources for working. Tags information can be stored in non-volatile memory. The tag consists of a Radio Frequency transmitter and receiver. Each tag can be assigned a unique serial number.

- **The RFID tech used here serves three main purposes:**
    a. **Dynamic Traffic Signal Control by measuring the density of traffic**
    b. **Controlling Red light violation**
    c. **Vehicle surveillance.**
- Each vehicle can be installed with an RFID tag. This RFID tag would store all the information regarding the vehicle such as the vehicle number, etc. RFID tags can be used in identifying each vehicle uniquely and also help the driver to receive some traffic messages.
- The RFID readers placed before the signals keep on detecting all the vehicles.
- A counter keeps on iterating and calculates the number of cars passing the signal in a fixed time.
- If a certain number of cars cross the signal during this time then the system works on a predetermined constant value of time, if the number of cars crossing is greater than that certain limit set, then the system automatically generates a delay and extends the time of the green signal.
- While the time of the green signal is increased the system will keep on calculating the number of cars crossing the junction. This will ensure that there is a minimum amount of congestion at the junctions.
- If there are no cars in a particular lane, the system will automatically assign a red signal to it and let the lane with a greater number of vehicles pass. The detection of cars to figuring out the density, all happen dynamically.
- The second issue is red light violators. As soon as any vehicle crosses the junction at a red signal(breaks the signal), the RFID reader gets all the RTO details of the violator and sends an alert automatically to him/her and deducts a fine for breaking the signal.
- UID of vehicles like ambulances, police vans, or any other emergency vehicle which cannot wait for the red signal to open, are allowed to cross the signal without any deduction of fine.

2.2 Algorithm to adjust the timer of a traffic signal:

Input:

- Max_red denotes the maximum time for which the signal can be red.
- Max_green denotes the maximum time for which the signal can be green.
- Min_freq_count denotes the minimum frequency of vehicles passing per second stored statically in controllers.
- Act_freq_count denotes the actual frequency of the vehicles passing per second = ∑vehicles/second.
- The timer denotes the actual timer count.

Algorithm:

1. When the signal turn green.

While (Timer<Max_green and Timer is not 0) do

If (Act_freq_count>Min_freq_count)

Keep the signal green.

Decrement timer count by 1.

Else if (Act_freq_count<=Min_freq_count)

Goto 2.

End

2. Make the signal red. Turn the adjacent signal green. Goto 1.

- **Example**: Suppose for a signal, the maximum time for which a signal can be red is set to be 30 seconds and the maximum time for which the signal can be green is set as 20 seconds. The controller is stored with the value of the minimum frequency of vehicles passing by it per second as 5. Now suppose the signal turns green, and the timer starts with a maximum value of 20. Initially, the frequency of the vehicles passing the signal per second is 10, after 10 seconds this frequency reduces to 5, and then automatically the RFID controller sends a command to the signal to turn red. Thus the signal turns red and its adjacent signal in that junction turns green. This process continues in a cycle. Thus dynamic controlling of the signal helps in reducing the wastage of time. This also

helps in avoiding traffic congestion as priority is given to a high vehicular traffic road.

- If the frequency of the vehicles passing the signal per second remains higher than the value set even though the maximum value of the timer is reached, then congestion has occurred at that point. Once the congestion has been detected, the RFID controller can send a message to its preceding signal's controller notifying it to temporarily stop traffic along that stretch. After receiving the message from its successor signal the RFID controller will put ON the red signal for that stretch towards that congested crossing point for a predefined time period. When the congestion is released at the crossing, the respective signal's controller will send another message to its earlier controller indicating to resume the traffic flow again in that direction. Accepting this message the controller of the preceding signal put the red light OFF and green signal ON and restarts the signal cycle as before.

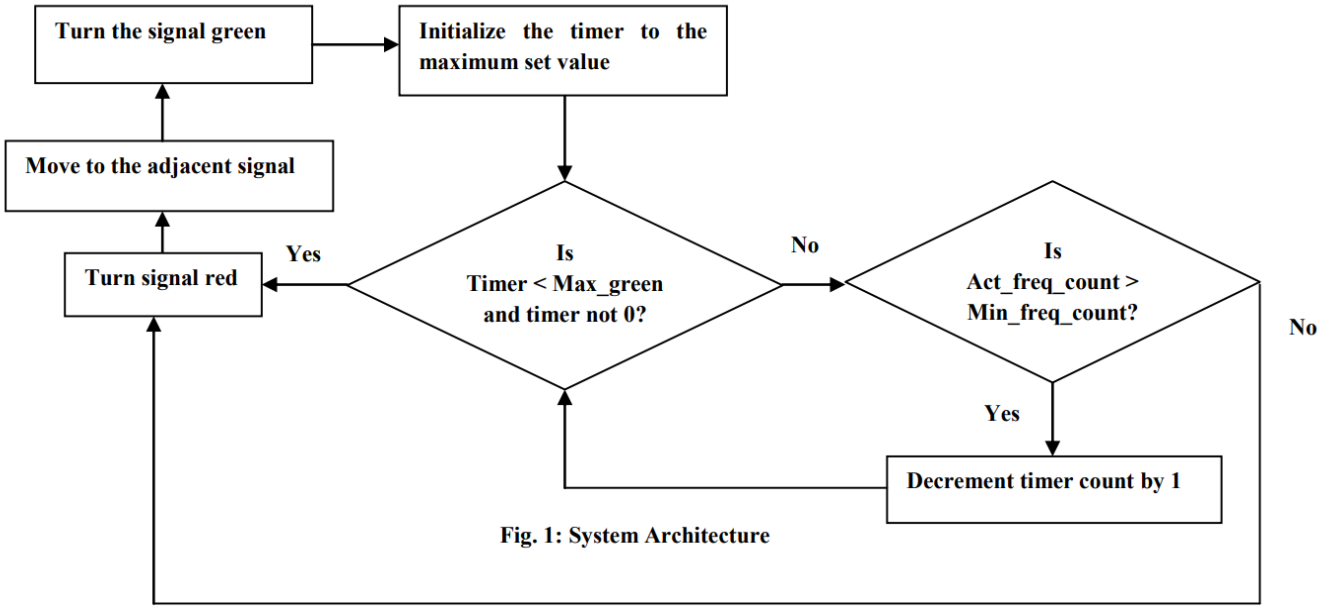

Fig. 1: System Architecture

The sequence of Execution:

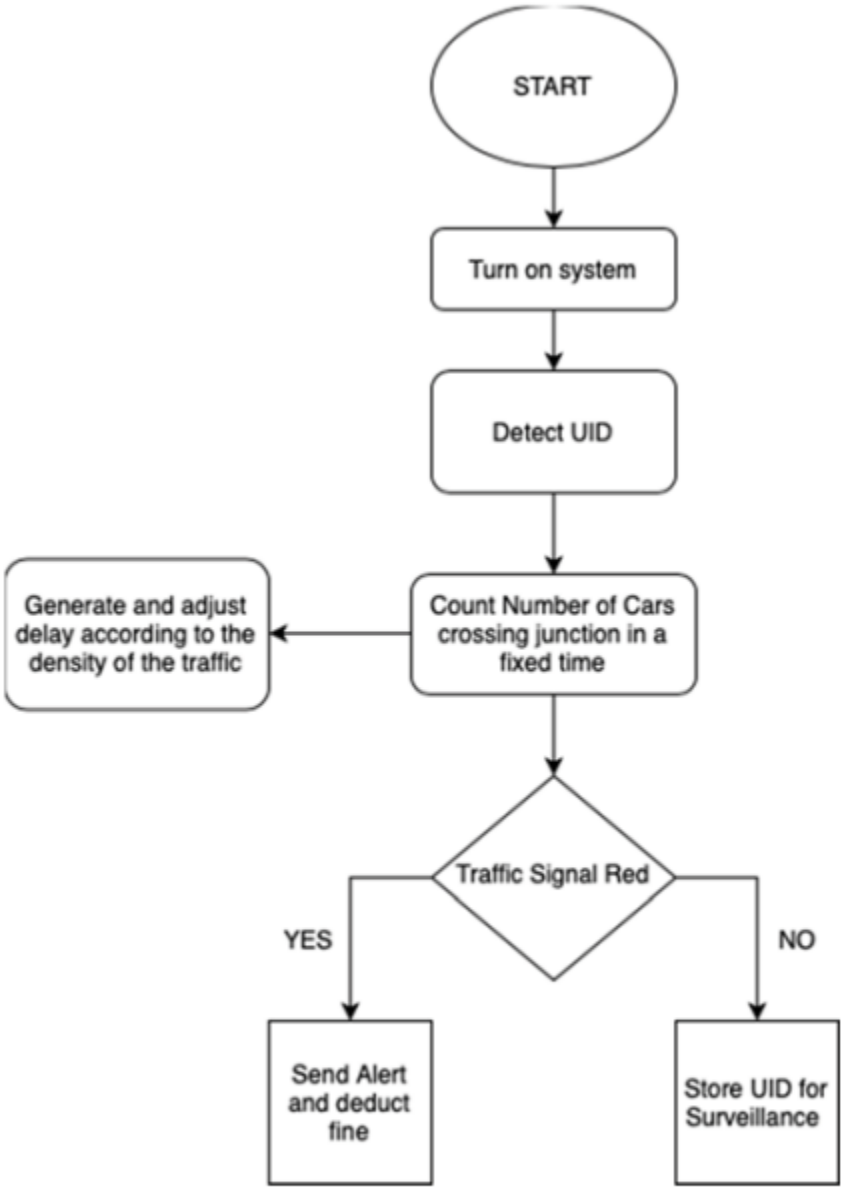

Fig. 2. Flowchart

Advantages of our proposed model:

1. Automated Traffic signals which changes the time dynamically according to volume of the traffic
2. Stolen vehicles can be tracked
3. Huge amount of data can be collected for analysis
4. Can be used to avoid incidents and accidents
5. Overcomes the failure faced by cameras where a considerable amount of violators are spared.

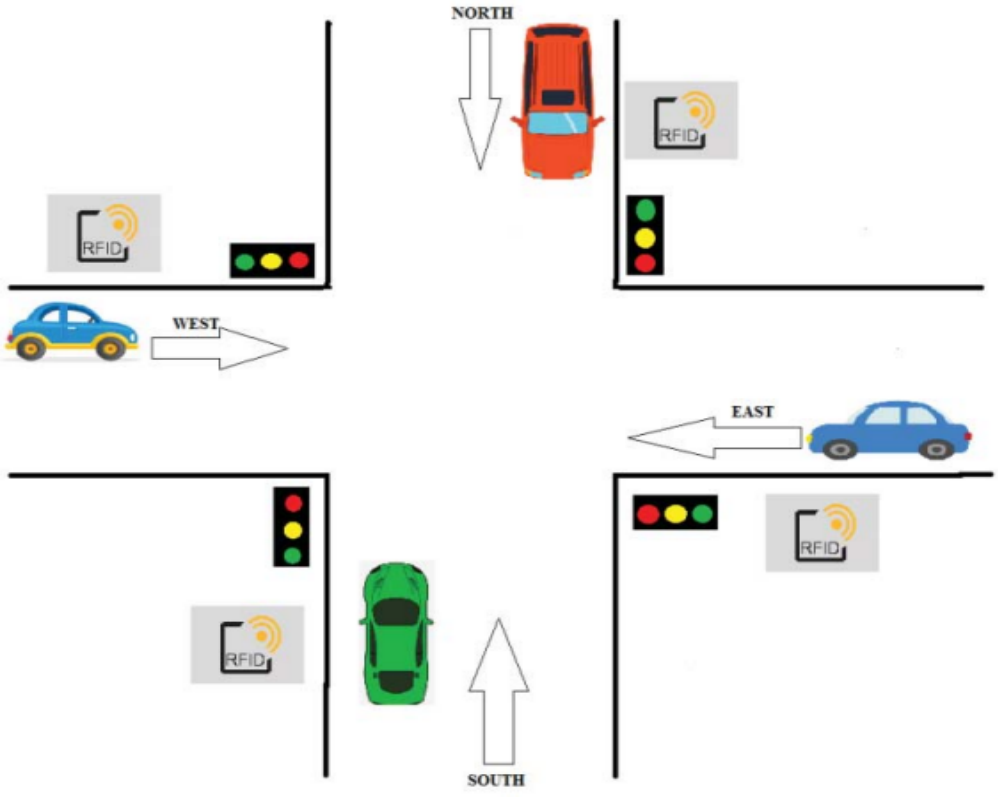

Fig. 1. Placement of RFID readers on a Traffic Junction