International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

Comparative study of traffic signal design using Webster and IRC method

Prasad Bollini, Akhila Mood *, Sumanth Kumar Chinna Paga and Yaswanth Kumar Dharamakari

Department of Civil Engineering, CMR College of Engineering & Technology (A), Kandlakoya (V), Medchal District, Hyderabad-501401, Telangana State, India.

International Journal of Science and Research Archive, 2024, 11(02), 1824–1831

Publication history: Received on 09 March 2024; revised on 17 April 2024; accepted on 20 April 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.11.2.0662

Abstract

In India, the growth of population plays an important role in increasing the congestion at intersections because every person uses a separate vehicle for movement due to this reason we know every day many people die in road accidents due to lack of traffic control system because all intersections are not well signalized. So, it is not possible to control the movement of vehicles by traffic police due to the increase in the number of vehicles at intersections.

Therefore, all intersections should be well signalized and traffic signals are specially designed for the emergency vehicles like Ambulance, Fire vehicles because emergency vehicles face delay at intersections when traffic is at red light and it is very dangerous for our society. In this project, Design of traffic signals is done with the help of the Indian Road Congress (IRC) and Webster's method at Gajularamaram service road intersection. Traffic signals are a better option for effective transportation.

Traffic signal systems are used to control the flow of vehicles with the help of traffic lights, where Many roads meet together and make a junction. Traffic volume studies are used to lay down mainly how many vehicles are moving on the road at a particular section during a particular time. Traffic signals are the best way to control vehicle movement at intersections without any accidents and conflicts.

Keywords: Traffic signal; Intersection; Congestion; Webster; IRC

1. Introduction

In order to have safe traffic operation on roads it is essential to impose adequate traffic regulations and traffic control devices .It is necessary to impress on the public that these regulations and controls are imposed on the public interest to ensure safety in general .The traffic regulations should cover all aspects of control of vehicles ,drivers and all other road users .The regulation should be rational .The following are some of the regulations that are enforced from the point view of safe traffic operations. Traffic regulations and laws give legal coverage for strict enforcement. The traffic laws implemented by legislative laws are obligatory on all road users. The laws should however, be uniform and clear the various aids and devices used to control, regulate and guide traffic may be called traffic control devices. The general requirements of traffic control devices are: attention, meaning, time for response and respect of road users. The most common among these are (a) Signs, (b) Markings, (c) Islands, (d) Signals. In addition, road lights are useful in guiding traffic during night. For example, they may impose restrictions on speed, on the turning of traffic at a junction or on waiting. Important exceptions are the Stop, Give Way and Keep Left signs Regulatory signs are either mandatory or prohibitory. A “Traffic Sign” means any object, device, line or mark on the road whose object is to convey to road users, or any specified class of road user, restrictions, prohibitions, warnings or information, of any description. The term Traffic Sign therefore includes not only signs on posts, but also road markings, delineators, road studs, traffic light signals and other traffic control devices.

* Corresponding author: M.Akhila.

2. Literature review

K. Vidhya, A. Bazila Banu, (2018), [1] have investigated and designed to develop a Density Based Dynamic Traffic Signal System. Across the world a large number of cities face the problem of traffic congestion. Nowadays the time of traffic flow is fixed lane by lane due to the density of vehicles. Sensors are used for observing the movements of automobiles and calculating the number of vehicles on the lane. When the density of the lane changes then the timing.

Nahar Nipa, Md. Mohibul Islam, (2018), [2] studied and decided to decrease the overall waiting time of traffic at intersections with the help of Intelligent Traffic Control System Based on Round Robin Scheduling Algorithm. This work is done with the help of a microcontroller for crossing the road junctions which are so busy. This project is proposed to develop less traffic

P. Saranya, Malliga Senthil (2022), [3] estimate the Cycle time of vehicles by Traffic controller with the help of Density Based adaptive Traffic Signal System. When all vehicles reach the area of vehicular network then that vehicle is registered and achieves a certificate from the roadside Unit. The Roadside unit counts the number of vehicles and transmits that data to the Traffic controller. And the traffic controller generated the cycle time for this vehicle according to the vehicle density at the intersection.

3. Methodology

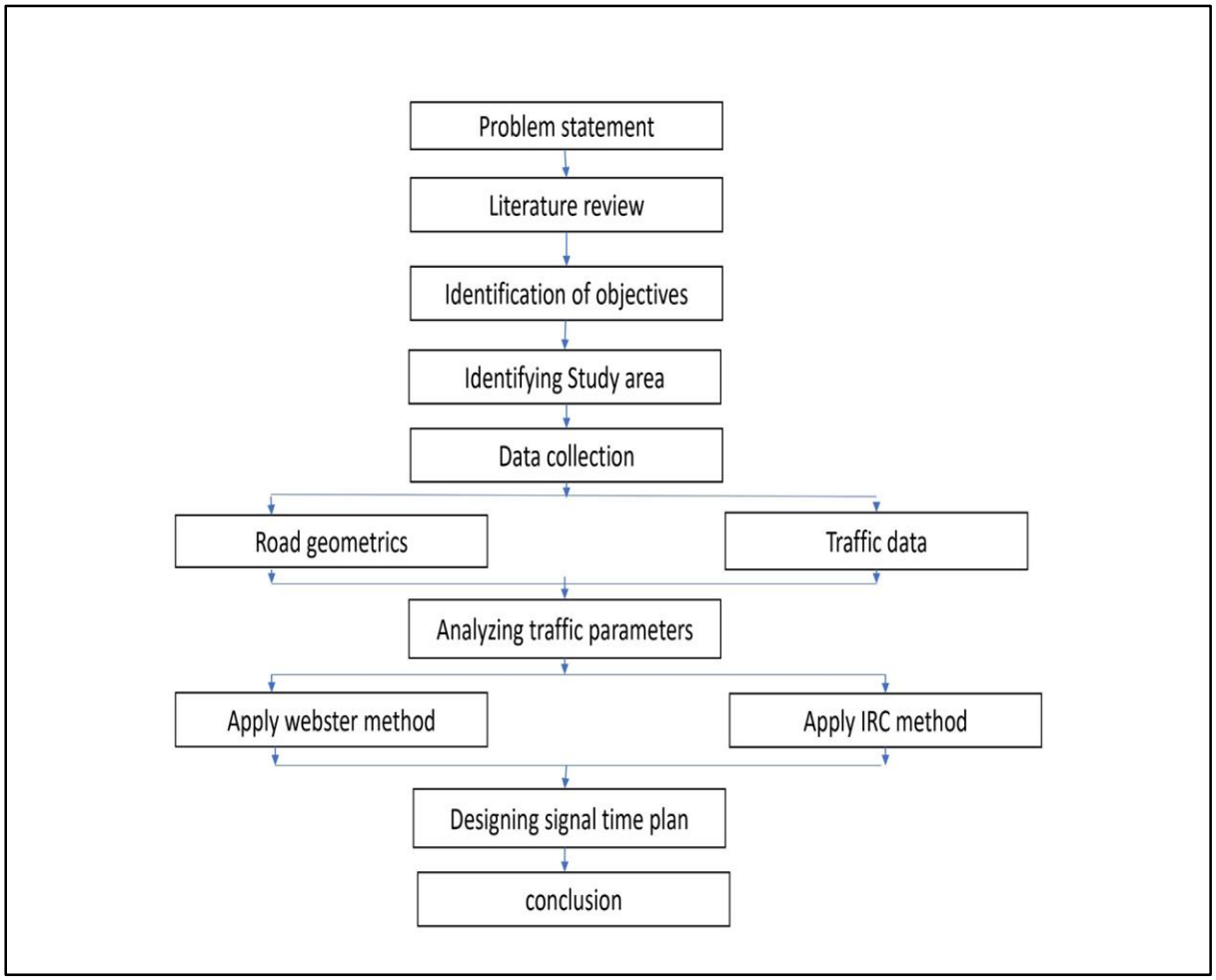

Figure 1 Methodology

3.1. Study Area

Gajularamaram junction is one of the fastest growing suburbs of Hyderabad, India. From the junction, the South Road leads to Bachpally, Bolarum, Miyapur and the North Road leads to Gandimaisamma, Medchal and the East Road leads to Gajularamaram T-Junction.

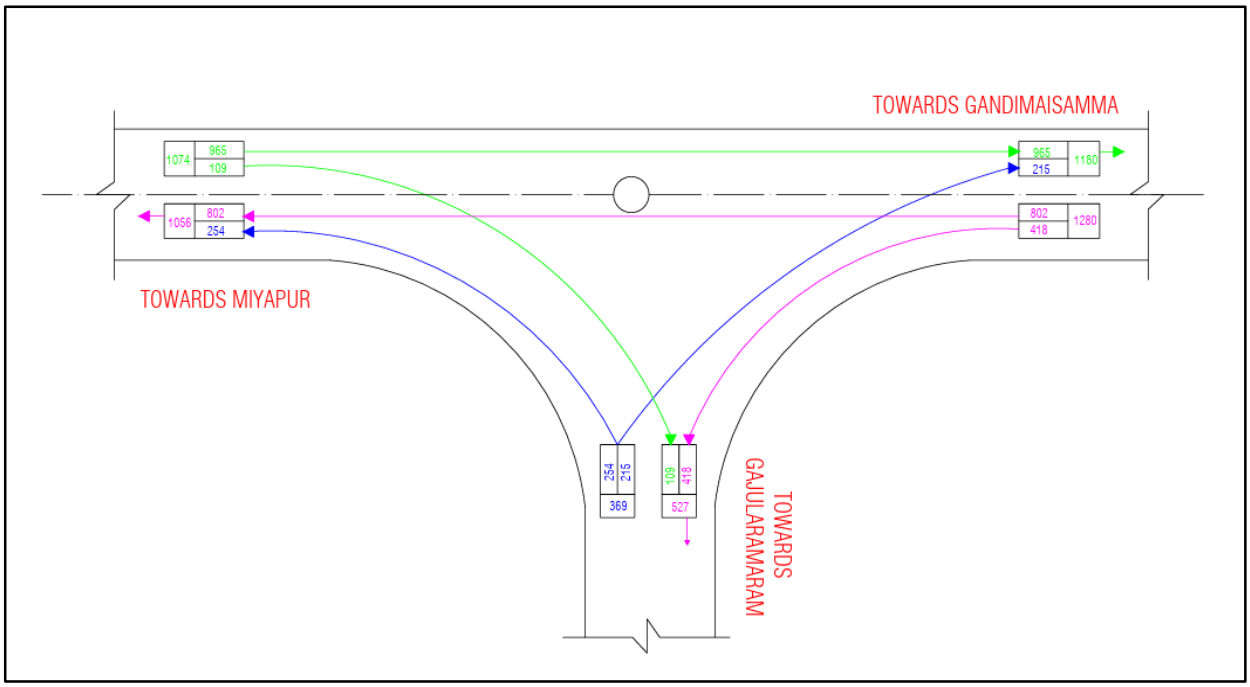

Figure 2 Gajularamaram T-Junction

3.2. Data collection

3.2.1. Manual Data Collection

In many field studies, manual data collection is considered essential. The group of the members takes up the Gajularamaram junction and vehicular volume is calculated manually. The data recorded manually is briefly explained below. For directional classified volume count, two enumerators were employed in each leg. Volume counts for each leg. Volume counts for each 15 minutes were recorded in the data sheet. One enumerator was employed for the measurement of road geometric.

While recording timings, care has been taken to select all the vehicles, which are approaching the intersection. It was also ensured to get representation of all the vehicles in the traffic stream. Fieldwork for 12 hours was carried out for a day (20th FEBRUARY, 2024) from 7:00 AM to 7:00 PM.)

3.2.2. Surveys Conducted

The basic objective of study was to analyze the present geometry of the road, its problems and to evolve a methodology for designing the traffic control devices. Accordingly different surveys are planned to fulfil these objectives. The surveys that are conducted in the field are

Topographic Survey

Traffic or Approach Flow Studies.

3.2.3. Design of Data Collection Sheets

By keeping in view all the above parameters a suitable data collection sheet was prepared. Classified volume by both direction and mode wise will be recorded in this sheet.

3.3. Vehicles approaching on each leg

Table1: Count of Vehicles on each Leg

No of legs	2w	3w	4w	Buses	Heavy vehicles	pedestrians
Leg-1	120	320	567	209	108	65
Leg-2	366	150	223	60	44	53
Leg-3	880	326	582	252	106	217

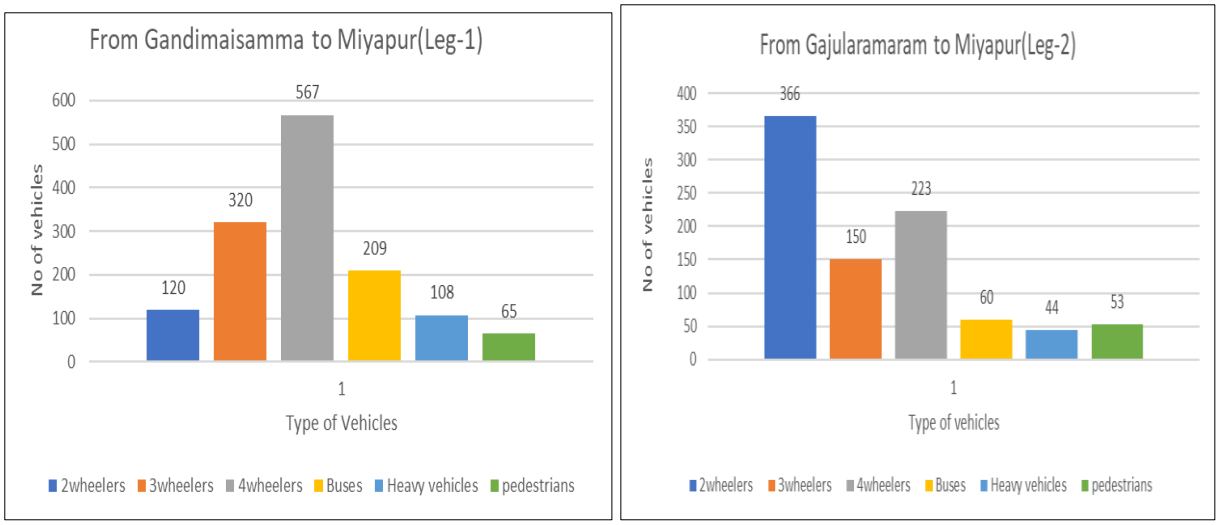

Figure 3 Bar graph showing count of vehicles in Leg 1 & Leg 2

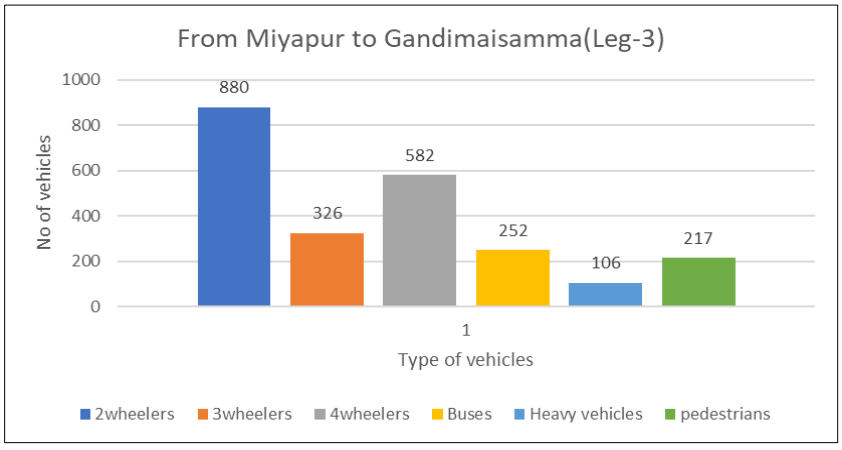

Figure 4 Bar graph showing count of vehicles in Leg 3

3.4. Processing of traffic data

The traffic volume data at the intersection was processed using MS EXCEL package. At the junction, the directional classified volume count data was obtained for every 15 minutes for a period of 8 hours.

3.5. Preliminary analysis of data

Preliminary analysis of the data reveals that the maximum PCU value on Leg 1 is 2400 PCU/hr, on Leg 2 is 890 PCU/hr, and Leg 3 is 2290 PCU/hr.

PCU Factors (As per IRC 106-1990)

Table2: PCU Values as per IRC

Types of vehicles	PCU value
2 Wheelers	0.5
3 wheelers	1.2
4 wheelers	1
buses	2.2
heavy vehicles	4

3.6. No of vehicles as per PCU/hr

Table 3 PCU Count on each Leg

No of legs	2w(PCU)	3w(PCU)	4w(PCU)	Buses(PCU)	Heavy vehicles (PCU)	Total(PCU)
Leg-1	560	383	567	461	429	2400
Leg-2	183	179	223	132	173	890
Leg-3	440	391	582	454	423	2290

The volume data is converted into PCU multiplying the no. vehicles of each mode with its appropriate PCU factor. The 15-min traffic volume data is then converted into hourly volume data. From the hourly data the design hourly volume in terms of PCU on each leg is obtained. The maximum hourly volume has been selected as design hourly volume for designing the signals

4. Results and discussion

4.1. Webster method

Table 4 Signal time as per Webster Method on each leg

No of legs	GREEN TIME(sec)	AMBER TIME (sec)	RED TIME (sec)	TOTAL CYCLE TIME (sec)
Leg-1	56.41	2	16	74.41
Leg-2	40.18	2	14	58.18
Leg-3	52	2	19	69.56

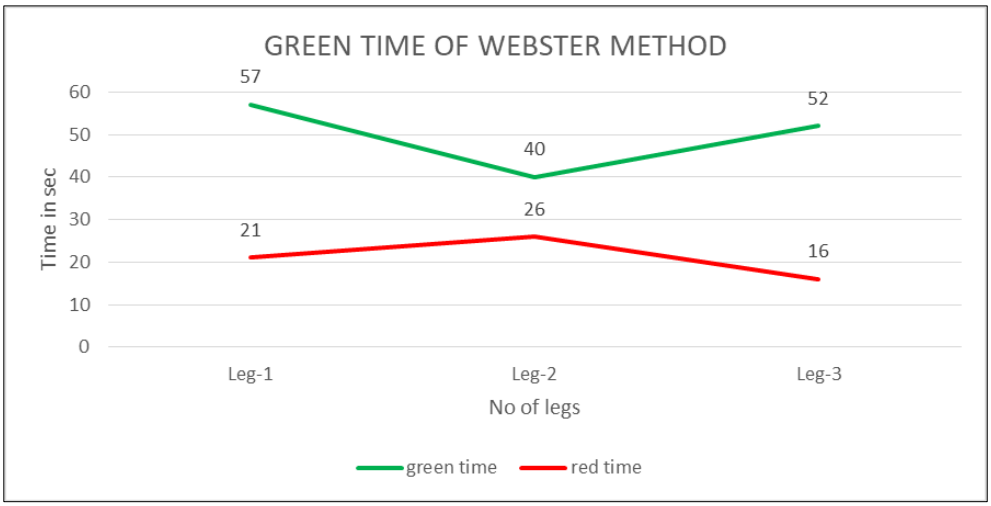

Figure 5 Graph showing red time and green time of Webster method

4.2. IRC method

Table 5 Signal time as per IRC Method on each leg

No of legs	GREEN TIME(sec)	AMBER TIME (sec)	RED TIME (sec)	TOTAL CYCLE TIME (sec)
Leg-1	45	2	32	81
Leg-2	32	2	48	81
Leg-3	44	2	36	81

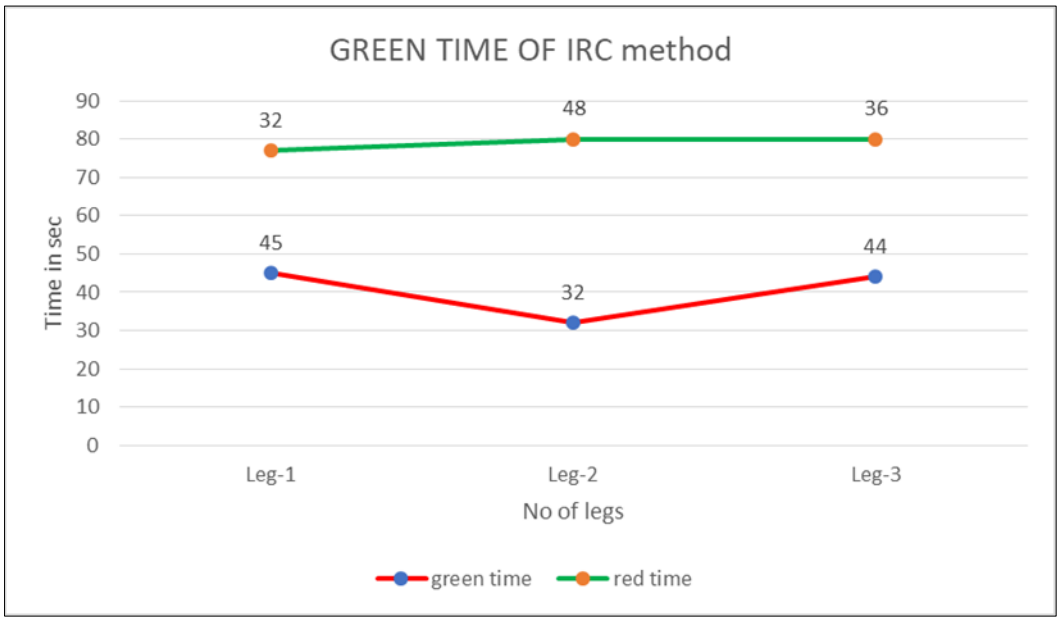

Figure 6 Graph showing red time and green time of IRC method

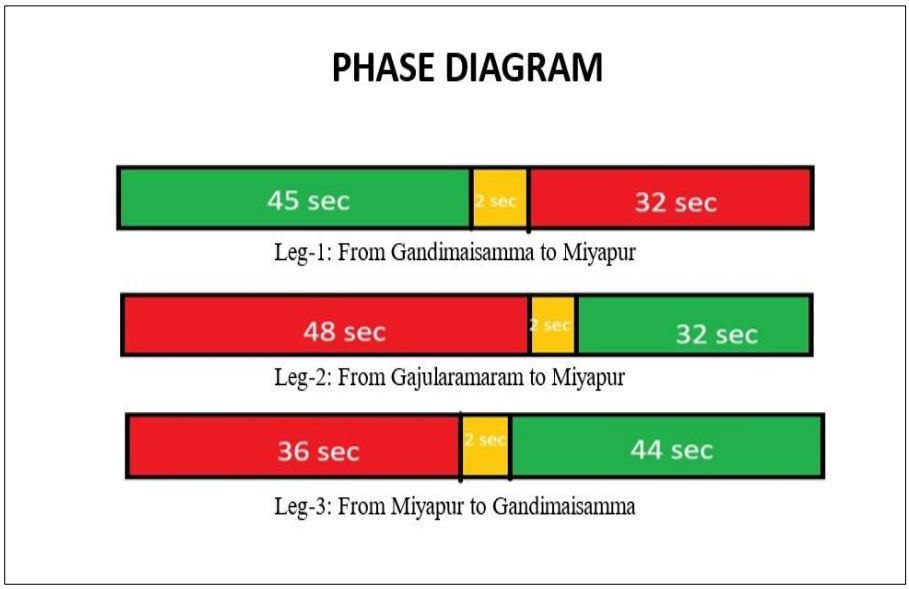

Figure 7 Phase Diagram

Traffic control signals should not be installed unless one or more of the following signal warrants are met. The necessary data should be collected by means traffic-engineering studies. To install signals at an intersection at least one warrant as mentioned in the earlier chapters should be satisfied. For the present study the design hourly volume is more than the motor vehicles per hour. So there is a need to establish a traffic signal at the Gajularamaram junction. So IRC method will be considered than webster method because webster method is not considering the vehicle count as IRC method.

Traffic control signals shall be installed at Gajularamaram junction for the following signal warrants meeting.

- As the average traffic flow for 8 hours on both approaches exceeds 800 vehicles.
- Interruption of continuous traffic flow on the major street exceeding 1000 vehicles per hour.
- As 150 or more pedestrians per hour cross a major street with over 600 vehicles per hour on both approaches.

The following information is concluded from our design.

- Total cycle time required in seconds= 81.00
- Actual green time for Leg 1= 45.00
- Actual green time for Leg 2= 32.00
- Actual green time for Leg 3= 44.00

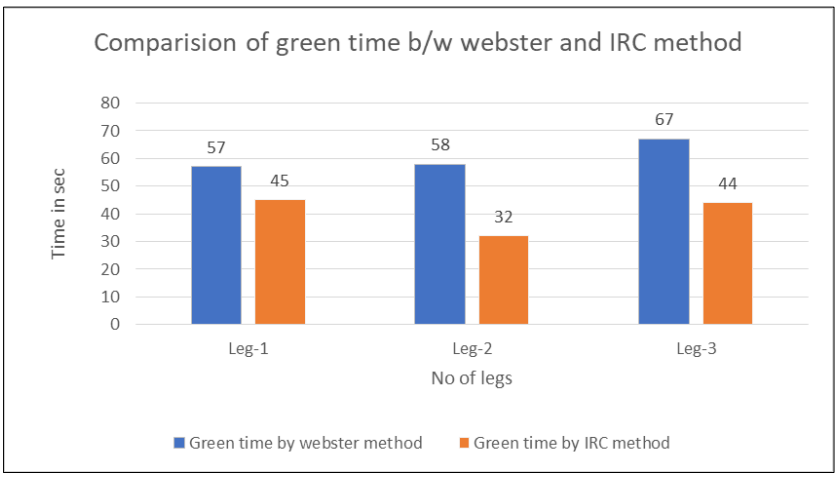

Figure 8 Graph showing comparison of green time between Webster and IRC method

5. Conclusion

The comparative study between Webster and IRC methods for traffic signal design at Gajularamaram junction revealed insights into optimizing traffic flow and addressing congestion. Through meticulous data collection and analysis, it was found that IRC method better accounts for vehicle count, thus providing more accurate signal timings. This study emphasizes the importance of implementing efficient traffic control systems to enhance road safety and mitigate congestion, ultimately benefiting society by improving transportation efficiency. Moving forward, further research in this area can contribute to refining traffic management strategies for better urban mobility and safety.

Compliance with ethical standards

Acknowledgments

We would like to express our sincere gratitude to the International Journal of Science and Research Archive for providing the platform for publishing this research article. We are also thankful to the reviewers for their valuable feedback and suggestions, which greatly contributed to improving the quality of this work.

Disclosure of conflict of interest

The authors declare that they have no conflicts of interest regarding the publication of this research article in the International Journal of Science and Research Archive

References

[1] Vidhya, K., & Banu, A. Bazila. (2018). "Density Based Dynamic Traffic Signal System: A Solution for Traffic Congestion." Journal of Transportation Engineering, vol. 2018, no. 1

[2] Nipa, Nahar, & Islam, Md. Mohibul. (2018). "Intelligent Traffic Control System Based on Round Robin Scheduling Algorithm for Intersection Management." Journal of Intelligent Transportation Systems, vol. 2018, no. 2, pp. 15-25.

[3] Saranya, P., & Senthil, Malliga. (2022). "Estimation of Cycle Time for Vehicles using Density Based Adaptive Traffic Signal System." IEEE Transactions on Intelligent Transportation Systems, vol. 2022, no. 3, pp. 45-55.

[4] Rengaraju, T. Rao, Vehicle-arrival characteristics at urban uncontrolled intersections, Journal of Transportation Engineering 121 (1995) 317–323.

[5] Q. Li, Z. Wang, J. Yang, J. Wang, Pedestrian delay estimation at signalized intersections in developing cities, Transportation Research Part A: Policy and Practice 39 (2005) 61–73.Journal of Advanced Research in Applied Sciences and Engineering Technology ISSN(online): 2462- 1943 | Vol. 2, No. 1. Pages 19-29, 2016 29 Penerbit Akademia Baru.

[6] Y. Bian, L. Jian, L.Zhao, Method to Determine Pedestrians Level of Service for Unsignalized Intersections, Applied Mechanics and Materials 253–255 (1943) 1936–1943.

[7] F.Pan,J.Lu,Q.Xiang,G.Zhang,Safety level of service at signal intersections, International Transportation Engineering Conference 2007 (2007) 1499–1504.

[8] B. P. Olszewski, Overall Delay, Stopped Delay, and Stops at Signal Intersections, Journal of Transportation Engineering 119 (1994) 835–852.

[9] F. Pan, L. Zhang, J. Lu, Unsignalized intersection level of service based on safety, Traffic and Transportation Studies Congress (2008) 645–652.

[10] Y. Ni, Z. Ling, K. Li, A New Evaluation Method Combining Efficiency and Safety: Multi modal Comprehensive Level of Service of Signalized Intersections, International Conference on Transportation and Infrastructure Safety 2000 (2013)1449–1457.

[11] X. Wang, M. Abdel-Aty, Modeling left-turn crash occurrence at signalized intersections by conflicting patterns, Accident Analysis & Prevention 40 (2008) 76–88