International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

EVALUATION OF UNCONTROLLED INTERSECTION PERFORMANCE BASED ON MICROSCOPIC SIMULATION

Vishal Kumar[*1], Tarif Hassan[*2], Utkarsh Raj[*3], Ayansh Gaurav[*4],Nitin Kumar[*5]

[*1,2,3,4]UGStudentsBE,DepartmentOfCivilEngineeringDSCE,Bengaluru,Karnataka,India.

[*5]Professor,DepartmentOfCivilEngineering,DSCE,Bengaluru,Karnataka,India.

ABSTRACT

Proximal Safety indicators like TTC (Time to collision), PET (post encroachment time), DR (Deacceleration rate), etc are used to study driver behaviour at mixed traffic conditions at Unsignalized intersections. post encroachment time is the Time between the moment that the first road user leaves the path of the second and the moment that the second reaches the path of the first. Traffic capacity at unsignalized intersections are analyzed with "Conflict Technique" and capacity intersections are determined using volume, speed, time data .Surrogate safety measures(SSMs) are used to evaluate safety at urban areas , Safety aspect in terms for pedestrian-vehicular conflicts are also analyzed, Designing of appropriate traffic signal at unsignalized intersections are also done with the aid of Webster method. By the aid of 3D simulation models, capacity and driver safety at unsignalized intersection is improved.

Keywords: Surrogate Safety Measures (SSMs), Advance driver assistance system (ADAS), Post encroachment time(PET), Emergency breaking system (EBS), Forward collision warning system(FCWS).

I. INTRODUCTION

The capacity of unsignalized intersection performs an important role in the evaluation of the road network capacity. In the case of urban scenario un-signalized intersection are the prime area of traffic accidents and obstructions. Accounting financial criteria it is not practicable to fit signal at every unsignalized intersection as they are fixed only on main arteries. Hence the microscopic of an unsignalized intersection is necessary.This microscopic analysis involves study of traffic characteristics like spot speed, volume , capacity , etc. Using concepts of Fuzzy logic artificial intelligence and machine learning. This traffic characteristics' can be calculated by using methods like green shield distribution method, moving car method.

Surrogate safety measures: Surrogate Safety Measure (SSM) is one of the most widely used methods for identifying future threats, such as rear-end collision. Various SSMs have been proposed for the application of Advanced Driver Assistance Systems (ADAS), including Forward Collision Warning System (FCWS) and Emergency Braking System (EBS).

Post-Encroachment Time (PET) : Time difference between the first vehicle leaving the course of the second between the first vehicle leaving the course of the second vehicle and the second vehicle reaching the course of the first vehicle.

Time To Collision (TTC) : The time required for two vehicles to collide if they continue at their present speed vehicles to collide if they continue at their present speed and along the same path.

Indo-HCM: Indian highway capacity manual used to categorize major and minor road and traffic in terms of PCU.

Yolo v5 : YOLOv5 is a model in the You Only Look Once (YOLO) family of computer vision models. YOLOv5 is commonly used for detecting objects. YOLOv5 comes in four main versions: small (s), medium (m), large (l), and extra-large (x), each offering progressively higher accuracy rates. Each variant also takes a different amount of time to train.

2.LITERATURE REVIEW

Naturalistic Driving Study -A Naturalistic Driving Study (NDS) is a research method used to collect real-world data on driver behavior, vehicle performance, and traffic interactions. Unlike traditional laboratory or simulator-based studies, NDS involves observing and recording drivers' actions in their natural driving environment.

Collisions in traffic -Collisions in traffic are caused by various factors such as distracted driving, speeding, impaired driving, following too closely, failure to yield, and disregarding traffic signals and signs.

Uncontrolled crossings - Uncontrolled crossings refer to pedestrian crossings that lack traffic control devices such as traffic lights or stop signs. These crossings rely on pedestrians and drivers to negotiate right-of-way based on their mutual awareness and judgment, often through eye contact and hand signals.

Surrogate Safety Measure - A Surrogate Safety Measure (SSM) is a metric or indicator that is used to estimate or predict the likelihood or severity of a road traffic crash. Unlike direct safety measures that directly assess crash occurrences, SSMs are typically based on observable surrogate variables that correlate with crash outcomes.

Post Encroachment Time - Post Encroachment Time (PET) is a surrogate safety measure used in transportation engineering to assess the safety of a pedestrian crossing or intersection. It refers to the time interval between when a pedestrian completes crossing the roadway and when the first conflicting vehicle passes the pedestrian's path.

Traffic network's bottleneck - A traffic network's bottleneck refers to a specific point or section within the network where the flow of traffic becomes constrained, resulting in reduced capacity and potential congestion. It is a critical location where the traffic volume exceeds the network's ability to handle it efficiently.

Pedestrian safety - Pedestrian safety at unsignalized intersections focuses on ensuring the safety of

pedestrians crossing the road without the presence of traffic signals. Measures to enhance safety include providing marked crosswalks, adequate visibility, traffic calming measures, signage, and education campaigns to raise awareness among both pedestrians and drivers.

Mixed traffic conditions - Mixed traffic conditions at unsignalized intersections refer to the coexistence of different types of road users, such as pedestrians, cyclists, and vehicles, without the presence of traffic signals. Managing safety in such conditions requires implementing measures like clear signage, designated crossing points, traffic calming measures, and promoting mutual awareness and respect among all users.

Driver behavior - Driver behavior at unsignalized intersections plays a crucial role in safety. Factors such as yielding to pedestrians, obeying right-of-way rules, maintaining appropriate speeds, and using proper signaling impact the overall safety and efficiency. Education, awareness campaigns, enforcement, and well-designed road markings contribute to promoting desired driver behavior at these intersections.

Simulation model - A simulation model is a computer-based representation of a real-world system or process. It is used to mimic the behavior and interactions of various components within the system to study their effects and make predictions. In the context of traffic and transportation, simulation models are commonly used to analyze and understand the dynamics of traffic flow, evaluate the impact of different scenarios or interventions, and optimize transportation systems.

Gap acceptance model - A gap acceptance model at unsignalized intersections is used to predict the behavior of drivers when deciding to enter or cross a roadway based on the size of available gaps in the traffic stream. It helps analyze factors like driver perception, decision-making, and gap selection to assess the safety and efficiency of intersection operations.

Binary logit model - A binary logit model, also known as a binary logistic regression model, is a statistical model used to analyze binary (two-category) outcomes. It is commonly applied in various fields, including economics, social sciences, and transportation.

Gap/lag time - Gap/lag time at unsignalized intersections refers to the time interval between the arrival of a vehicle at an intersection and its decision to enter or cross the intersection based on the presence of sufficient gaps in the conflicting traffic stream.

Critical gap - The critical gap at an unsignalized intersection refers to the minimum time or distance required between consecutive vehicles in the conflicting traffic stream to allow a driver to safely enter or cross the intersection. It is a key parameter used to determine the availability of sufficient gaps for safe maneuvering and to assess the level of safety at unsignalized intersections.

Traffic Capacity - Traffic Capacity at an unsignalized intersection refers to the maximum number of vehicles or pedestrians that can pass through the intersection within a given time period without experiencing excessive delays or congestion. It depends on factors such as lane configurations, traffic volumes, driver behavior, and the efficiency of intersection operations.

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

3.OBJECTIVE

❖ **TO STUDY THE VOLUME OF TRAFFIC :** To study traffic volume, methods such as traffic counting, surveys, automatic monitoring systems, machine learning, and traffic simulation models are used to collect and analyze data on vehicle flow and patterns.

❖ **TO ANALYSE THE CAPACITY OF UNSIGNALISED INTERSECTIONS :** Analyzing the capacity of unsignalized intersections involves studying factors such as traffic volume, vehicle movements, gap acceptance to determine the maximum number of vehicles that can pass through the intersection efficiently.

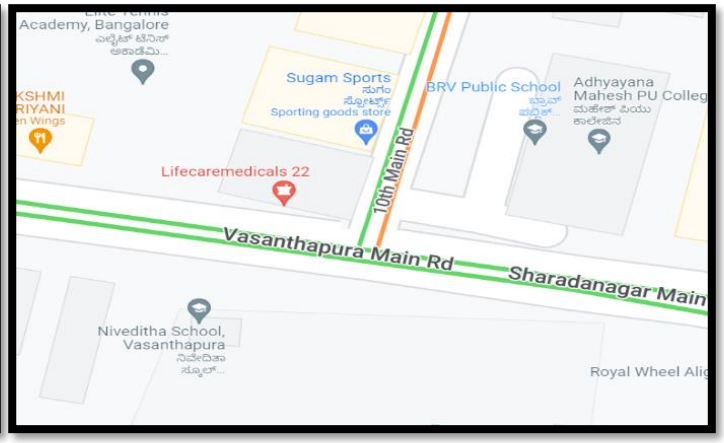
❖ **TO MODEL DRIVER BEHAVIOUR USING YOLO V5:** Using YOLO v5, driver behavior can be modeled by training the algorithm on annotated video data, detecting and tracking vehicles, and analyzing their movements, such as lane changes, speed, and interaction with other vehicles or objects.

4.STUDY AREA

INTERSECTION 1 - 4 Legged Cross

Banshankari stage 5, Isro Layout,Bengaluru

INTERSECTION- 2 - T Intersection

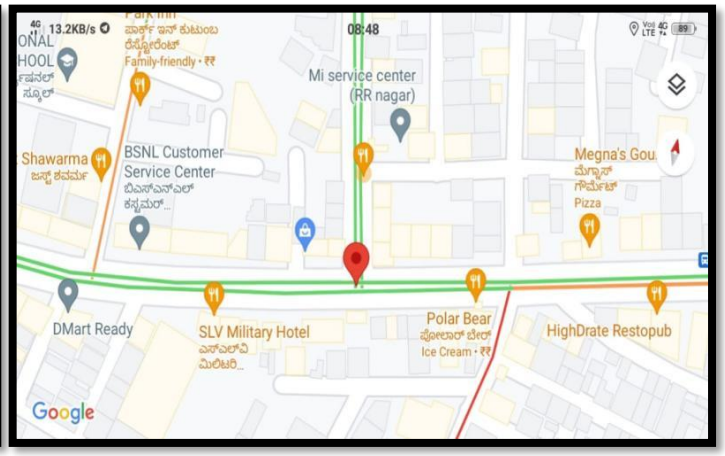


10th Main Road Prasanti Nagar, Isro layout

INTERSECTION 3- T-Intersection

14th Cross Road, Vikram nagar, Isro layout

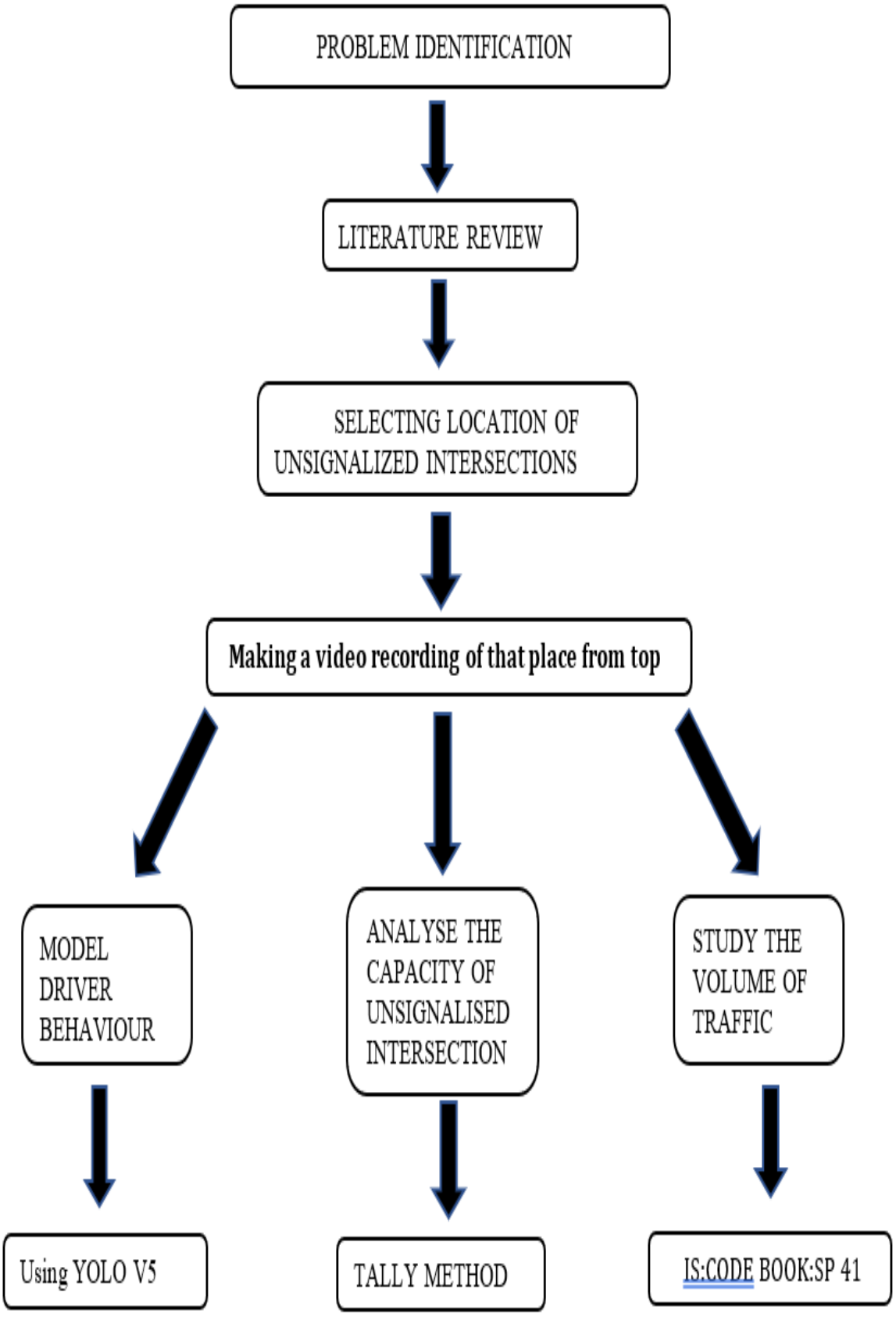
INTERSECTION 4- T-Intersection



5TH Stage, RR Nagar, Bengaluru, Karnataka 560098

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

5.METHODOLOGY



➢ Problem identification- Identify the unsignalized intersections where there are more conflicts and collisions of the vehicles.

➢ To do literature review on journal papers related to volume study, driver behaviour and capacity.

➢ Selection of the unsignalized intersections (4-way, T-intersections)

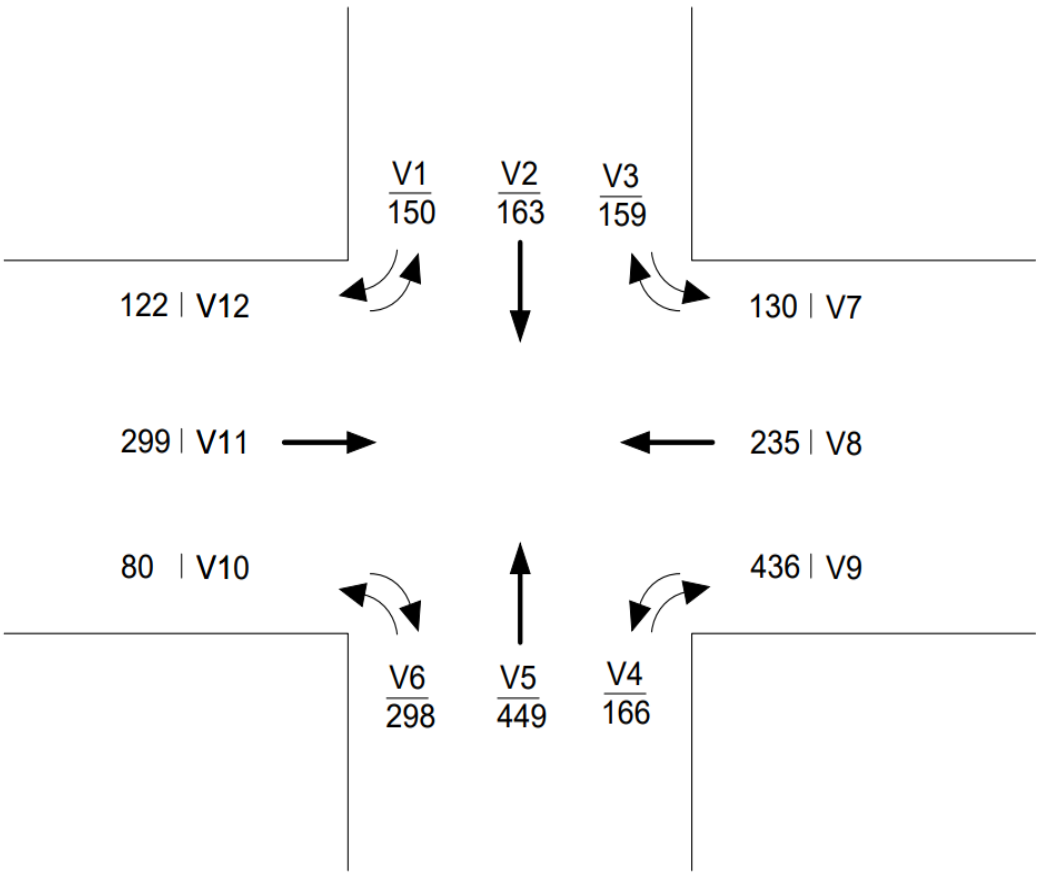
➢ Calculate number of vehicles during peak hours

➢ Taking video recordings of the intersections during morning and evening peak hour. For identification of volume and capacity of the traffic.

➢ Volume study and capacity analysis is done using tally method & IRC SP-41.

➢ To model driver behaviour using YOLO V5.

6. CALCULATIONS



Banshankari stage 5, Isro Layout,Bengaluru

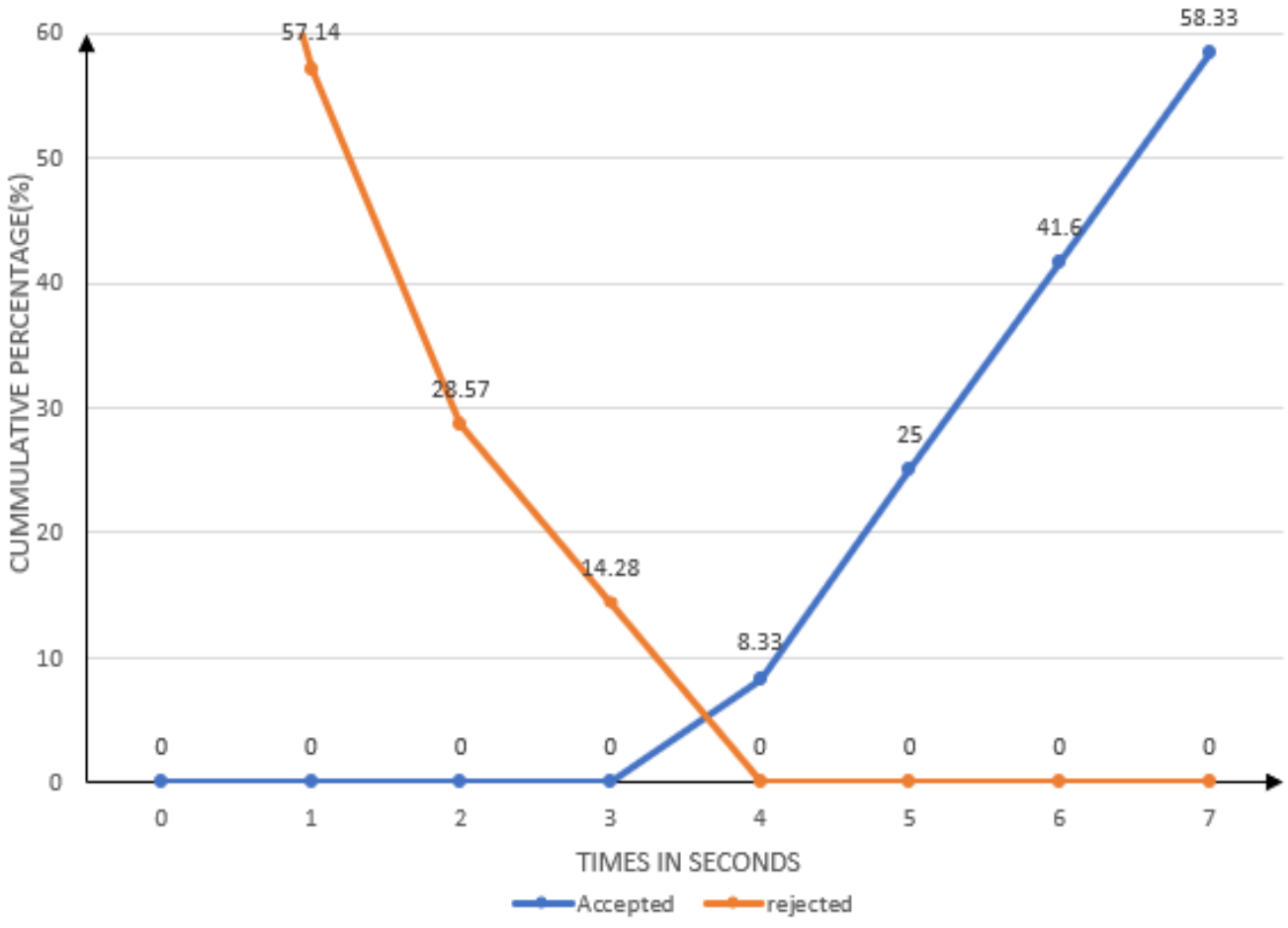
International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

CRITICAL GAP CALCULATIONS:

V7 (RIGHT TURN)

SECONDS	ACCEPTED	REJECTED
0	0	100
1	0	57.14
2	0	28.57
3	0	14.28
4	8.33	0
5	25	0
6	41.6	0
7	58.33	0
8	75	0
9	100	0

INTERSECTION 1- cross-Intersection



International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

DETERMINATION OF LOS

Movements	V(pcph)	Cm(pcph)	CR=CSH-V	LOS
V7	144	15.1	-129	F
V8	224	184.8	-39	F
V9	424	930	506	A
V10	97	7.8	-89	F
V11	237	192.1	-44	F
V12	96	610	514	A
MOVEMENTS	**V(pcph)**	**CM(pcph)**	**CR=CSH-V**	**LOS**
V1	142	580	438	A
V4	173	920	747	A

7.RESULT & CONCLUSION

The capacity of unsignalized intersection performs an important role in the evaluation of the road network capacity. In the case of urban scenario un-signalized intersection are the prime area of traffic accidents and obstructions. Accounting financial criteria it is not practicable to fit signal at every unsignalized intersection as they are fixed only on main arteries. Hence the microscopic of an unsignalized intersection is necessary.

This microscopic analysis involves study of traffic characteristics like spot speed, volume , capacity , etc. Using concepts of Fuzzy logic artificial intelligence and machine learning. This traffic characteristics' can be calculated by using methods like green shield distribution method, moving car method.

From the present studies carried out following conclusions can be derived:

1. As per the findings from capacity calculations using **IRC SP 41**, Level of service was observed to be varying between **LOS A** to **LOS F**. Here**, LOS F** was seen in most of the right turn and through movements and **LOS A** was observed in left turn movements.
2. From **IRC SP 41,** it can be observed that the capacity for the directions as through from **minor street(V11**) was seen to reach the values of **91%,** which concludes the necessary traffic regulatory action such as installation of a traffic signal in the respective direction.
3. It can be concluded that drivers found difficulty in manoeuvring their vehicles in right direction where the time required was found between **03 sec** to **05 sec**.

4. It was also found that vehicles with larger dimension took more clearance time in all the intersections studied in this project.
5. From the volume studies carried out, it can be concluded that driver behaviour is aggressive in taking a right turn and through movement than left turn movement. Two wheelers were found more aggressive than drivers who were driving cars, which can be seen from the lower values of clearance time taken by the two wheelers during the study.

8. REFERENCES

[1] Yingfeng(Eric) Li, Haiyan Hao ,Ronald B. Gibbons And Alejandra Medina (2021**)** "Understanding Gap Acceptance Using Behaviour At Unsignalized Intersections Using Naturalistic Driving Study Data", Journal Of Transport Research Record

[2] Satish Chandra And Mithun Mohan (2018) "Analysis Of Driver Behaviour At Unsignalised Intersection",Journal Of Indian Road Congress Anand Samir, Sanket Thorat And Budharatna Godboley(2015)"Assessment Of Traffic Safety Performance At Unsignalized Tintersection Under Mixed Traffic Condition", Ijarse,Vol.No.4,Issue 04,April 2015.

[3] Manish Dutta And Mokaddes Ali Ahmed (2017)"Gap Acceptance Behaviour Of Drivers At Uncontrolled T-Intersections Under Mixed Traffic Conditions" Springer.

[4] Joewono Prastijo,Ning Wu,Kamarudin Ambak,Mohd Erwan Sanik,Basil David Saniel,Josef Hadipramana (2015)"Performance Of Non-Priority Intersections Under Mixed Condition Based On Conflict Streams Analysis", Springer.

[5] Jaydip Goyani,Nishant Pawar,Ninad Gore,Manish Jain, Shriniwas Arkatkar(2019) "Investigation Of Traffic Conflicts At Unsignalized Intersections For Reckoning Crash Probabilty Under Mixed Traffic Condition", Eastern Asia Society.

[6] Joewono Prasetijo,Mehndi Hossein Pour,Seyed Mohammad Reza Ghadiri (2011)"Capacity Of Unsignalized Intersections Under Under Mixed Traffic Condition", Elsevier Ltd.

[7] Jaladhi V.Chitaria,Parth D.Patel(2020 "Analysis Of An Unsignalized Intersection In Ahmedabad City"Jetir.

[8] Avinash Chaudhari,Ninad Gore,Shriniwas Arkatkar(2020)"Exploring Pedestrian Surrogate Safety Measure By Road Geometry At Midblock Crosswalks", Production And Hosting By Elsevier Ltd.

[9] Isam A.Kaysi And Ali S.Abbany (2007**)**, "Modelling Aggressive Driver Behaviour At Unsignalized Intersections", Elsevier.

[10] Nishant Pawar,Ninad Gore And Shriniwas Arkatkar (2019), "Influence Of Driving Enviroment On Safety At Unsignalized T-Intersection Under Mixed Traffic Conditions"Springer Nature Singapore Pte Ltd.2019

[11] Miaomiao Liu,Yongsheng Chen And Guangquan Lu(2016), "Modelling Crossing Behaviour Of Driver At Unsignalized Intersection With Consideration Of Risk Perception"Edp Sciences

[12] Bozhao Shen,Zhiqing Zhang, Hao Liu And Wenjiao Qiao (2017)"Analysis Of The Effect Of Warning Facilities On Driving Behaviour At Unsignalized Intersection"Asce

[13] Meghana Prakash And Ravi V (2021),"Driving Behavior Study Using Hybrid Machine Learning Framework With Recommendation System"Jetirmanish Dutta, Kamalnath Maddu And Suprava Jena (2021), "Studying AggressiveClearing Behaviour Of Drivers At Uncontrolled Intersections Under Mixed Traffic Conditions"Doi.Org.