LEADER
Civil Engineering and Architecture Journal

Civil Engineering and Architecture Journal Vol 2 No. 1 (2024) 3026-622X
DOI 10.37253/leader.v2i1.9524

# ANALYSIS OF UNSIGNALIZED INTERSECTIONS: CASE STUDY OF THE INTERSECTION OF JALAN SUKARAJA WETAN, MAJALENGKA

**Ghaida Tsauraya Nur Fatimah[1], Andri Irfan Rifai[2].**
[1]Civil Engineering Study Program, Fakulty of Engineering , Universitas Majalengka
[2]Fakulti of Civil Engineering and Planning, Universitas International Batam, Indonesia
Emai korespondensil: ghaidatsawraya@gmail.com

***ARTICLE INFO***

***Keywords:***

*Traffic control and signalized intersections*

***ABSTRACT***

*Traffic signs are the main thing that is very important for road users; of course, they help in terms of safety and security for drivers. Unsignalized traffic signals at intersections have been identified as the most dangerous locations in traffic. Not only in other countries, Indonesia has also implemented traffic signs at intersections, especially on highways. This journal aims to analyze factors that increase the risk of traffic jams and are prone to morning, afternoon, and evening accidents at the intersection of Jalan Sukaraja Wetan-Kulon, Jatiwangi District, and Majalengka Regency. This research was located at an unsignaled intersection, precisely at the Sukaraja Wetan-Kulon intersection, Jatiwangi sub-district, Majalengka district. The method used in this journal is quantitative methods. The Sukaraja Wetan-Kulon intersection has four approaches; each approach has two lanes. The data was obtained from calculating traffic volume, which involved conducting a survey directly at the location, namely in the field for two days, and divided into two, namely total flow volume and flow volume of main roads and minor roads. The basic capacity (Co) obtained at the intersection of four Sukaraja Wetan-Kulon roads is 2/2 UD, which is 2900. At the junction of four, the level of service depends on the degree of saturation, which has been obtained from the traffic flow value divided by the load capacity. The conclusion from this research is that the data obtained in the chapter above shows that peak traffic flow occurs on Tuesdays in the afternoon period at 16.00-17.00 with a total traffic flow volume of 7818.2 pcs/hour. The capacity of the Jalan Simpang Empat Sukaraja Wetan-Kulon greatly influences the value of the degree of saturation.*

## 1. Introduction

Traffic signs are the main thing that is very important for road users; of course, they help in terms of safety and security for drivers. Unsignalized traffic signals at intersections have been identified as the most dangerous locations in traffic. Traffic accidents are still a major problem for motorists. Besides poor intersection design, intersection crashes may also be caused by driver's inappropriate behaviors from multiple aspects of the driver-vehicle environment system [1]. Therefore, high traffic conditions can trigger traffic problems such as congestion and accidents in several countries.

As traffic means of transportation increases in developing countries in Asia. This can cause several traffic problems, such as an increase in the number of vehicles becoming increasingly crowded. This density causes traffic jams and is prone to traffic accidents. In India, about 49% of the total accidents on Indian roads occurred at intersections [2]. Drivers who do not properly understand the conditions of the roads they are traveling on can increase the number of accidents in Asian countries. Therefore, to overcome this problem, efforts to improve the level of service at intersections now and in the future include implementing traffic signs.

Not only in other countries, Indonesia has also implemented traffic signs at intersections, especially on highways. However, there are no traffic signs on most rural roads at intersections due to a lack of infrastructure, such as inadequate road width. But it's not just the insufficient road width; it could also be other factors. Happening problem traffic that a crease in the volume of vehicles in the area intersection will influence the capacity intersection so that level performance then across the intersection will decrease and divides user traffic will cause loss like cost and time trip highway is one infrastructure for smoothness traffic good in a city nor rural or area other [3]. Traffic problems at unsignalized intersections have very large and relatively higher traffic hazards.

Likewise, in the Majalengka Regency, the implementation of traffic signs at intersections is minimal, meaning traffic jams will occur and are prone to accidents. This is caused by the growth in the number of vehicles, both motorbikes and cars, in Indonesia, which is quite large and is not balanced with road capacity. With the increase in population, there has been a development in every sector, starting from the social, economic, and cultural sectors, which are made by consumptive, productive, public services, distribution services, and government, demanding an increase in transportation needs that are in harmony and balanced to support daily activities [4]. The existence of this area can result in traffic jams and accidents on certain days, such as morning, afternoon, and evening, when students, workers, and traders go to their places of activity. The problem with traffic signs is not only from population density and inadequate roads but also drivers, who are also a factor in the high potential for traffic accidents, such as using increased speeds and sudden braking.

This journal aims to analyze factors that increase the risk of traffic jams and are prone to accidents in the morning, afternoon, and evening at the intersection of Jalan Sukaraja Wetan-Kulon, Jatiwangi District, Majalengka Regency. This four-way intersection is very vulnerable so that it can pose a big risk to road users. Traffic jams and accidents are a problem that needs greater attention. Based on this, the researcher is interested in writing a journal titled Analysis of Unsignalized Intersections: Case Study of the Sukaraja Wetan-Kulon Road Intersection Four, Jatiwangi District, Majalengka Regency.

## 2. Literature Review

### 2.1 Traffic

Traffic is a series of rules, devices, and infrastructure regulating roads. Traffic is the movement of vehicles, pedestrians, and other transportation in a certain area or route. Meanwhile, traffic space, namely traffic regulation, involves traffic rules, signals, and road infrastructure. Passing traffic is an action with a vehicle that requires obeying traffic rules. Social optimization emerged as a strategy to attain more efficient road traffic [5]. In this case, if you want to achieve more efficient traffic, you must comply with traffic properly.

Traffic is a means of infrastructure for mobility and interaction between individuals, vehicles, and goods to move and carry out daily activities. Along with current developments, the population in an area or city is increasing, so the number of vehicles is increasing with population density. The significant increase in cars in urban areas raises the challenge of urban mobility [4, 6]. So the smooth flow of traffic becomes hampered because many vehicles are passing by, which can cause congestion. To overcome this problem, you must comply with traffic regulations so that traffic will be effective.

With effective traffic, smooth traffic becomes comfortable for road users. With the development of society and the economy, the extraordinary growth of the vehicle population has brought about increasing traffic control pressure [7]. Not only from vehicles increasing but from the drivers themselves, if they are effective in traffic, it will not lead to road congestion. Another hope is that orderly traffic can be conditioned so that every road driver can obey all the rules, such as signs, traffic signals, and traffic management by officers. Thus, following traffic can help reduce the risk of accidents.

Exploring cost-effective traffic management solutions to relieve traffic congestion and emissions has become one of the most significant challenges faced by transportation authorities, especially in developing countries [8]. Traffic management attempts to regulate and control traffic flow and infrastructure to ensure efficiency, safety, and smooth driving. Traffic management aims to obtain a high level of accessibility and comfort and increase safety for motorists. The systemic approach, introduced in recent years in several road safety agencies worldwide, is an alternative method to address safety issues [9]. Safety is important when driving to reduce the number of traffic accidents.

### 2.2 Intersection

An intersection is where two or more roads meet, and vehicle paths intersect. Intersections are part of highways and public roads due to intersections' efficiency, security, comfort, and safety. As one of the vital elements in road networks, road intersections play a crucial role in road network construction, route planning, and automatic driving [10]. The existence of intersections in a road network so that motorized vehicles, pedestrians, and cars can move in different directions simultaneously. Understanding these factors is vital for improving road safety in developing countries [11]. Therefore, the paths meet at the intersection, allowing traffic flow to change direction.

Intersections are critical areas where many accidents take place, causing more deaths [12]. Current traffic management is less effective in overcoming congestion problems at intersections. This is because traffic congestion is influenced by several factors that are related to each other. In overcoming the above issues, it is necessary to carry out maximum work effectiveness to create good traffic. To increase the efficacy in traffic, discipline, traffic services, transportation management, and traffic infrastructure must be improved.

Interchanges can effectively save travel time, reduce environmental pollution, reduce road congestion, and conserve energy. Efforts to improve transportation, such as infrastructure, and improving the quality of infrastructure. This can create a safer area, as well as improve the quality of life in the community. This awareness can enhance vehicle safety and transportation efficiency considerably [13]. Thus, the intersection is where a decision point or action can be taken optimally to achieve the desired goal.

To improve safety at intersections for motorists, starting from the community itself, comply with security and order so that traffic jams will not occur. This regulation applies to every community or individual who uses road facilities. This is a matter of walking and driving and ensuring safe traffic. Traffic safety at intersections is greatly influenced by driver discipline; increasing driving discipline can improve traffic safety. Thus, it is necessary to control and regulate traffic conflicts resulting from automobiles by applying convenient strategies [14].

### 2.3 Unsignalized Intersection

An unsignalized intersection is where a highway and a rural road meet, where vehicles can turn in a different direction or continue traveling without traffic signals. Applying safety measures is essential to reduce the severity and frequency of crashes at unsignalized intersections [15]. So, traffic signs play a very active role in highway traffic or rural roads. If there are no traffic signs, traffic jams and accidents will occur. Traffic signals must be implemented at unsignalized intersections to avoid traffic jams.

For drivers approaching an intersection, besides controlling the vehicle speed, expanding the range of perception is also an important element in improving driving performance [16]. In this case, unsignalized intersections are still a big problem for road users. But discipline in driving is also very important; people's undisciplined behavior in traffic includes using high speeds, breaking through road barriers, and not equipping safety equipment. So, the low level of indiscipline when driving can cultivate

an undisciplined attitude in society. Even though it is an unsignalized intersection, road users still need to be disciplined in driving.

Congestion often occurs on highways and rural roads; in this case, congestion often happens in big cities and small towns. Road transportation is considered very important for the day-to-day activities of mankind, whether in terms of the social or economic status of a country [17]. This condition is caused by the increasing number of vehicles that exceed the capacity available on the road. Capacity estimation at such intersections is usually more complicated than signalized intersections [18]. The impact of traffic jams can result in losses and inconvenience for motorists. The solution to the causes of traffic jams is efforts to improve infrastructure, such as widening roads and adding traffic lanes to avoid traffic jams.

Even though intersections constitute a relatively low proportion of the transportation system facilities, a significant number of crashes occur at this location, especially in urban areas [19]. If traffic problems often occur, especially in unsignalized intersection areas, obstacles can arise. These obstacles are in the form of traffic jams and are prone to accidents; this requires more attention. However, it is not only congestion that needs to be considered, but the aspect of infrastructure at unsignalized intersections cannot be ignored. Therefore, it is important to pay attention to traffic infrastructure and give priority to other drivers to maintain smoothness and safety.

## 3. Method

### 3.1 Types of Research

The method used in this journal is quantitative methods. Quantitative research is a form of research that relies on the methods of natural sciences, which produces numerical data and hard facts [20]. This quantitative method is applied to make observations and count the number of vehicles to see the activity trend at the intersection. However, this approach requires a lot of real data to represent different traffic scenarios because the vehicles' movements are always the same [21]. Thus, this research uses survey techniques directly to the location of the unsignaled intersection.

### 3.2 Research Location

This research was located at an unsignaled intersection, precisely at the Sukaraja Wetan-Kulon intersection, Jatiwangi sub-district, Majalengka district. The research locations are in Figure 1. Research locations.

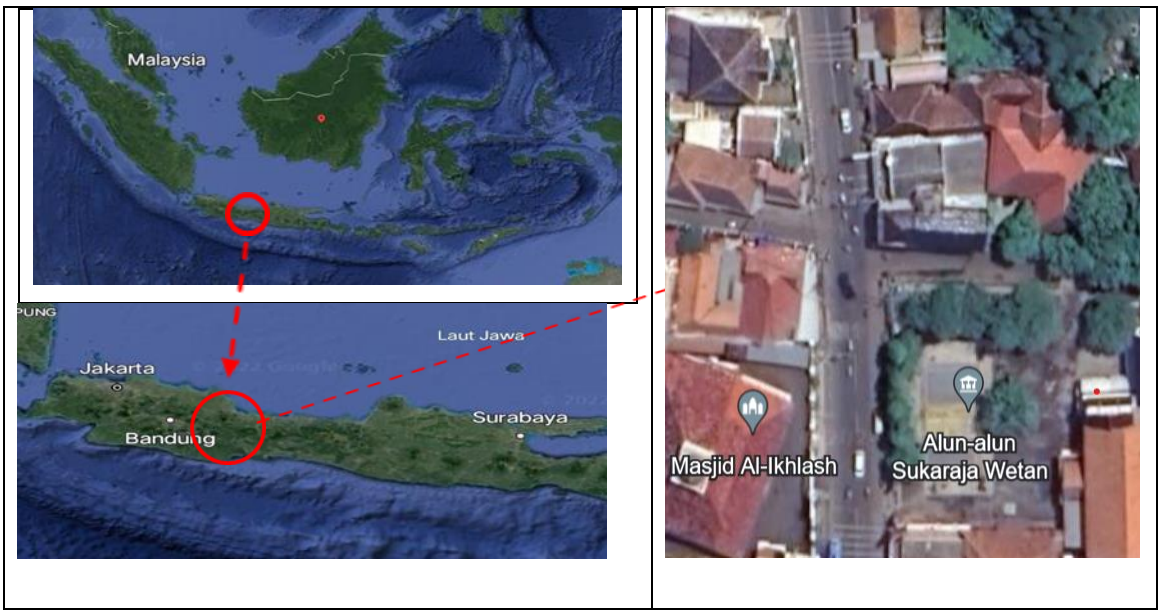


**Figure 1**. Research Location

### 3.3 Data Collection

Data collection in research management is intended to obtain materials, information, facts, and reliable information [22]. The data collection sources used for calculating traffic flow are primary and secondary data. Preliminary data is the result of a direct survey of the target location with data obtained directly in the field to obtain geometry and traffic flow data. Data collection is responsible for defining the research problem and outlining the research design/plan [23]. Therefore, the main aim of the research is to obtain data directly from the research object.

This survey was carried out over two days, Sunday and Tuesday. Traffic flow observations are carried out within 1 hour, divided into 15 minutes, where each period is carried out in the morning, afternoon, and evening. The survey at the Sukaraja Wetan-Kulon signalless intersection was carried out at four points: at the first point on the northern part of the Sukaraja-Jatiwangi road, the second point on the eastern part of the Sukaraja Wetan-Cibentar road, the third point on the southern part of the Sukaraja-Cigasong road, and at the fourth point on the Sukaraja Kulon-Gunung Sari. At each approach at intersection four, there is one surveyor to record and count vehicles. So, there were four surveyors at the four intersections to get data.

## 4. Result and Discussion

### 4.1 Geometric Data

The Sukaraja Wetan-Kulon intersection has four approaches; each approach has two lanes where each approach has different road conditions. Three main routes and one minor road at the Sukaraja Wetan-Kulon intersection. The geometric conditions of the Sukaraja-we-Kulon non-signalized intersection are in Table 1.

**Table 1**. Intersection Geometric Data

| No. | Approach | Effective Width | Road Conditions |
|---|---|---|---|
| 1. | A. (Sukaraja-Jatiwangi) | 8 | Mayor |
| 2. | B. (Sukaraja wetan-Cibentar) | 8 | Mayor |
| 3. | C. ( Sukaraja-Cigasong) | 8 | Mayor |
| 4. | D. (Sukaraja kulon-Gunung sari) | 5 | Minor |

*Source: MKJI 1997*

### 4.2 Traffic Volume

**Table 2.** Intersection Geometri Data

| Traffic Flow | Direction | LV | | HV | | MC | | Total Vehicles | |
|---|---|---|---|---|---|---|---|---|---|
| | | kend/jam | emp=1,0 | kend/jam | emp=1,3 | kend/jam | emp = 0,5 | kend/jam | smp/jam |
| A. (Jl. Sukaraja-Jatiwangi) | LT | 255 | 255 | 51 | 66.3 | 685 | 342.5 | 991 | 663.8 |
| | ST | 663 | 663 | 40 | 52 | 989 | 494.5 | 1692 | 1209.5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| North | RT | 152 | 152 | 25 | 32.5 | 665 | 332.5 | 842 | 517 |
| Total | | 1070 | 1070 | 116 | 150.8 | 2339 | 1169.5 | 3525 | 2390.3 |
| B. (Jl. Sukaraja wetan-Cibentar) East | LT | 182 | 182 | 26 | 33.8 | 770 | 385 | 978 | 600.8 |
| | ST | 205 | 205 | 37 | 48.1 | 921 | 460.5 | 1163 | 713.6 |
| | RT | 142 | 142 | 22 | 28.6 | 578 | 289 | 742 | 459.6 |
| Total | | 529 | 529 | 85 | 110.5 | 2269 | 1134.5 | 2883 | 1774 |
| C. (Jl. Sukaraja-Cigasong) South | LT | 155 | 155 | 28 | 36.4 | 999 | 499.5 | 1182 | 690.9 |
| | ST | 380 | 380 | 52 | 67.6 | 876 | 438 | 1308 | 885.6 |
| | RT | 110 | 110 | 25 | 32.5 | 759 | 379.5 | 894 | 522 |
| Total | | 645 | 645 | 105 | 136.5 | 2634 | 1317 | 3384 | 2098.5 |
| Jl. Utama Total | | 2244 | 2244 | 306 | 397.8 | 7242 | 3621 | 9792 | 6262.8 |
| D. (Jl. Sukaraja kulon-Gunung sari West | LT | 198 | 198 | 10 | 13 | 515 | 257.5 | 723 | 468.5 |
| | ST | 357 | 357 | 25 | 32.5 | 768 | 384 | 1150 | 773.5 |
| | RT | 225 | 225 | 8 | 10.4 | 156 | 78 | 389 | 313.4 |
| Jl. Minor Total | | 780 | 780 | 43 | 55.9 | 1439 | 719.5 | 2262 | 1555.4 |
| | | | | | | | | | |
| Major+Minor | LT | 790 | 790 | 115 | 149.5 | 2969 | 1484.5 | 3874 | 2424 |
| | ST | 1605 | 1605 | 154 | 200.2 | 3554 | 1777 | 5313 | 3582.2 |
| | RT | 629 | 629 | 80 | 104 | 2158 | 1079 | 2867 | 1812 |
| | | | | | | | | | |
| Major+Minor Total | | 3024 | 3024 | 453.7 | 453.7 | 8681 | 4340.5 | 12054 | 7818.2 |
| | | | | | | | | | |
| Rasio Jl. Minor/(Jl. Major + Minor)Total | | | | | | | | | 0,7182 UM/MV |

*Source: MKJI 1997*

The data was obtained from calculating traffic volume, which involved conducting a survey directly at the location, namely in the field for two days, and divided into two, namely total flow volume and flow volume of main roads and minor roads. Therefore, the traffic flow review results show an LV of 3024 pcu/hour, an MC of 4340.5 pcu/hour, and an HV of 453.7 pcu/hour. The main road obtained a total of 6262.8 pcu/hour and on minor roads a total of 1555.4 pcu/hour. The peak hour received on Tuesday was 16.00-17.00, with a traffic volume of 7818.2 pcs/hour. The results of this traffic volume can be seen in Table 2. Traffic Flow.

### 4.3 Capacity

**Table 3.** Road Capacity

| Direction | Basic Capacity (Co) | FW | FM | FCS | FCsf | FRT | FLT | FMI | Capacity ( C ) |
|---|---|---|---|---|---|---|---|---|---|
| Nourth | 2900 | 1,19 | 1 | 1 | 0,82 | 0,84 | 1,33 | 0,258 | 901,985 |
| East | 2900 | 1,19 | 1 | 1 | 0,82 | 0,84 | 1,33 | 0,258 | 901,985 |
| South | 2900 | 1,19 | 1 | 1 | 0,82 | 0,84 | 1,33 | 0,258 | 901,985 |
| West | 2900 | 1,03 | 1 | 1 | 0,73 | 0,84 | 1,33 | 0,258 | 725,555 |

*Source: MKJI 1997*

The basic capacity (Co) obtained at the intersection of four Sukaraja Wetan-Kulon roads is 2/2 UD, which is 2900. At the north, east, and south approaches, the width is 8 meters with a value of 1.19. Meanwhile, the width of the western approach is 5 meters with a value of 1.03. The separation factor for the median direction of the road at the Sukaraja Wetan-Kulon intersection is 50:50, so the value obtained in the 1997 MKJI is 1.

After that, the size of the city of Majalengka in 2021 will be 1.3 million, and the MKJI value will be 1. Thus, the side resistance factor in the west direction is classified as high, while the side resistance factor in the north, east and south directions is classified as very high with a value MKJI 0.82. In the west direction, the MKJI value is 0.73. Then, the respective turn ratio factors for left turns are 1.33 and the right turn ratio factors are 0.84. So from this data, a calculation of the road capacity at Simpang Empat Sukaraja Wetan-Kulon can be obtained, which can be seen in table 3. Road Capacity.

### 4.4 Level of Service

**Table 4.** Level of Service

| Direction | Traffic Flow (Q) smp/jam | Capacity ( C) smp/jam | Degre of Saturatio(DS) | LOS |
|---|---|---|---|---|
| North | 2390,3 | 901,985 | 2,650044069 | Buruk |
| East | 1774 | 901,985 | 1,966773283 | Buruk |
| South | 2098,5 | 901,985 | 2,326535364 | Buruk |
| West | 1555,4 | 725,555 | 2,143738242 | Buruk |

*Source: MKJI 1997*

The level of service at this intersection depends on the degree of saturation which is obtained from the traffic flow value divided by the road capacity. So, the value of the degree of saturation for each road is obtained, in the north direction it is 2.65, in the east direction it is 1.96, in the south direction it is 2.32, and in the west direction it is 2.14. The result of this degree of saturation makes the level of service at Simpang Empat Sukaraja Wetan-Kulon very unstable.

## 5. Conclusion

The conclusion from this research is that the data obtained in the chapter above, peak traffic flow occurs on Tuesdays in the afternoon time period at 16.00-17.00 with a total traffic flow volume of 7818.2 pcu/hour. The capacity of the Jalan Simpang Empat Sukaraja Wetan-Kulon greatly influences the value of the degree of saturation. In the above chapter, the number of degrees of saturation in the north, east, south and west directions is very high, which can cause poor service levels. Therefore, the results of this research can be concluded that the level of service at Simpang Empat Sukaraja Wetan-Kulon will be more optimal if the road capacity is adequate and the road can be enlarged so that the saturation degree value will be low and cannot cause very high congestion.

## References

[1] G. Li, Y. Wang, F. Zhu, X. Sui, N. Wang, X. Qu and P. & Green, "Drivers' visual scanning behavior at signalized and unsignalized intersections: A naturalistic driving study in China," *Journal of Safety Research,* vol. 71, pp. 219-229, 2019.

[2] S. Chandra and M. & Mohan, "Analysis of driver behaviour at unsignalized intersections," *Jurnal of the Indian ROADS congress,* vol. 79, no. 2, pp. 5-10, 2018.

[3] D. T. Pitri, "Performances Analysis of Unsignaled Intersection at Lawe Sigala-Gala of Intersection and Semadam Itersection, Southeast Aceh Regency," *International Journal of Economic, Technology and Social Sciences,* vol. 2, no. 2, pp. 617-628, 2021.

[4] M. Isradi, N. D. Nareswari, A. I. Rifai and J. & Prasetijo, "Performance Analysis of Road Section and Unsignalized Itersections On Jalan Cileungsi Setu and Jalan Raya Narogong," *International Journal of Engineering, Science & Informaton Technology,* vol. 1, no. 2, pp. 72-80, 2021.

[5] F. Koller, "What determines the acceptance of socially optimal traffic coordination?: A scenario-based examinatin in Germany," *Transportation Research Part A: Policy and Practice,* vol. 149, pp. 62-75, 2021.

[6] R. G. Witeck, A. M. A. Rocha, O. G. Silva, S. Antonio, D. Dalila and M. Jose., "A bibliometric review and analysis of traffic lights optimization," *International Conference On Computational Science and Its Applications ,* pp. 43-54, 2022.

[7] Q. Ma, S. Zhang and Q. & Zhou, "Develoment of aconflict-free unsignalized intersection organization method for multiple connected and autonomous vehicles," *Organization method connected and autonomous vehicles,* vol. 16, no. 3, p. 0249170, 2021.

[8] D. Li and J. & Lasenby, "Mitigating urban motorway congestion and emmisions via active traffic management," *Research Transportation Business & Management,* vol. 48, p. 100789, 2023.

[9] A. G. C. M. J. L. J. &. A.-A. M. Montella, "Systemic approach to improve safety of urban unsignalized intersections: Development and validation of a Safety Index," *Accident Analysis & Prevention,* vol. 141, p. 105523, 2020.

[10] Y. Liu, R. Qing, Y. Zhao and Z. & Liao, "Road Intersection Recognition via Combining Classification Model and Clustering Algorithm Based on GPS Data," *ISPRS International Journal of Geo-Information,* vol. 11, no. 9, p. 487, 2022.

[11] A. Syekhfard, F. Haghighi, S. Bakhtiari, S. Moridpour, K. Xie and G. & Fountas, "Analysis of traffict conflicts with righturning vehicles at unsignalized intersections in suburban areas," *Internasional Journal of Transportation Science and Tehnology,* 2023.

[12] S. Khaled, O. M. Shehata and E. I. & Morgan, "intersectioncontrol for autonomous vehicles using control barrier function approach," *Novel Intelligent and Leading Emerging Aciences Conference (NILES),* pp. 479-485, 2020.

[13] M. O. Sayin, C. W. Lin, S. Shiraishi, J. Shen and T. & Başar, "Information-driven autonomus intersection control via incentive compatible mechanisms," *IEE Transactions on Intelligent Transportation System,* vol. 20, no. 3, pp. 912-924, 2018.

[14] M. S. Imran and H. A. C. & Ewadh, "Iprovement of traffic control at intersection sites," *IOP Conference Series; Materials Science and Engineering,* vol. 870, no. 1, p. 012095, 2020.

[15] Y. Rachakonda and D. S. & Pawar, "Evaluation of intersection conflict warning system at unsignalized intersections: A review," *Journal of Traffic and Transportation Engineering (English Edition),* 2023.

[16] Y. Huang, Y. Wang, X. Yan, K. Duan and J. & Zhu, "Behavior model and guidance strategies of the crossing behavior at unsignalized intersection in the connected vehicle environment," *Transportation research part F: traffic psychology and behaviour,* vol. 88, pp. 13-24, 2022.

[17] I. O. Olayode, L. K. Tartibu, M. O. Okwu and D. U. & Uchechi, "Intelligent transportation system, unsignalized road intersections and traffic congestion in Johannesburg; A systematic review," *Procedia CIRP,* vol. 91, pp. 844-850, 2020.

[18] J. Chitaria and P. & Patel, "Analysis of an Unsignalized Intersection in Ahmedabad city," *International journal of recent research incivil and mechanical engineering (IJRRCME),* vol. 6, no. 2, pp. 26-31, 2020.

[19] S. A. Arhin and A. & Gatiba, "Predicting Injury Severity of Angle Crashes Involving Two Vehicles at Unsignalized Intersection Using Artificial Neural Networks," *Engineering Technology & Applied Science Research,* vol. 9, no. 2, 2019.

[20] S. Ahmad, S. Wasim, S. Irfan, S. Gogoi, A. Srivastava and Z. & Farheen, "Qualitative v/s. Quantitative Research- A Summarized Review," *Population,* vol. 1, no. 2, 2019.

[21] S. Jeong, Y. Baek and S. H. & Son, "Component-Based Interactive Framework for Intelligent Transportation Cyber-Physical Systems," *Sensors,* vol. 20, no. 1, p. 264, 2020.

[22] Q. Aini, Z. Zaharuddin and Y. & Yuliana, "Compilation of criteria for types of data collection in management of research methods," *Aptisi Transactions on Management,* vol. 2, no. 2, pp. 97-103, 2018.

[23] S. A. Mazhar, R. Anjum, A. I. Anwar and A. A. & Khan, "Methods of data collection: A fundamental tool of research," *Journal of Integred Community (ISSN 2319-9113),* vol. 10, no. 1, pp. 6-10, 2021.