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Evaluation Of The Influence Of Traffic Lights on Traffic Comfort And Safety Users: Case Study of Cigasong Roundabout, Majalengka City

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ABSTRACT

Recognizing traffic lights is an essential technological advancement. element for automated driving in urban areas. Traffic signs are one of the essential elements in the transportation system that regulate, warn, and provide information to road users. Traffic signs are designed to improve safety, efficiency, and convenience in driving. The purpose of this investigation is to find the one lack influence of movement signs traffic comfort and safety and see the impact on motorists; traffic lights reduce accidents. This study is located at the Cigasong roundabout. The research study employs a qualitative methodology. with perception analysis. Parameters are respondents' perceptions of the level of importance and satisfaction with traffic light signs on the road, using a scale of 1 to 5 from not crucial to important and dissatisfied to satisfied. The data was processed using the Importance Performance Analysis (IPA) method. The data collected from 25 respondents were divided by age, gender, and the vehicle used when crossing the Cigasong roundabout. From the questionnaire results, the majority of the age range that has passed through the Cigasong roundabout is less than 20 years and 21 to 30 years, and the least frequent passing through the Cigasong roundabout is age 41 to 50. While the majority of the gender that has passed through the Cigasong roundabout is male. Most road users who have passed through the Cigasong roundabout use motorbikes, and the least frequently use cars.

1. Introduction

Traffic light recognition is an indispensable elemental technology for automated driving in urban areas (Yoneda et al., 2020). Signs such as stop signs, traffic lights, or one-way lane signs help regulate vehicle movement to reduce congestion and conflicts, especially at intersections or congested areas.

Traffic signs are one of the essential elements in the transportation system that regulate, warn, and provide information to road users. For signalized junctions to be safe and functional, the change interval—which includes the yellow and all-red times—is essential. In order to avoid making conflicting decisions, drivers must not only choose whether to stop or continue, but also communicate with other cars in front of and behind them during this time. (Hussain, Alhajyaseen, Brijs, Pirdavani, & Brijs, 2020).

Roundabouts with traffic signals at the Kadipaten intersection are one of the centres of activity in this area, with traditional markets, shops, and terminals (Firmansyah, Rifai, & Taufik, 2022). Transportation aims to make traffic and road transportation safe, fast, smooth, orderly, orderly, comfortable, and

efficient, and it can be used with other means of transportation. The increasing number of people using transportation will cause problems such as traffic jams or accidents. Road conditions, crossroads, vehicles on the road, season, and flaws in the traffic signal management system all contribute to congestion. (Sahputra, Rastami, Damanik, & Ivanna, 2023).

Along with the development of Majalengka City, more and more people are coming for recreation or settling there. As a result, the population of Majalengka City will increase. One of the most apparent problems due to the increase in population is traffic congestion (Kumar, Kumar, & Das, 2021). Because of the larger population, issues such as control and design require a thorough understanding of the operational features of today's traffic; traffic studies are essential for traffic engineers. In Indonesia, traffic studies are necessary for transportation management planning.

The purpose of this study is to examine the location Cigasong roundabout, where traffic signs have recently died, and see the impact on motorists. When passing through bundaran cigasong, Majalengka, the respondents' data was divided into gender, vehicle used, and age (Dwiani, Rifai, Taufik, & Handayani, 2024).

2. Literature Review

2.1 Traffic Light System Introduction

Traffic is one of the indispensable problems of modern societies, which leads to undesirable consequences such as time wasting and a greater possibility of accidents (Damadam, Zourbakhsh, Javidan, & Faroughi, 2022).Traffic lights regulate the movement of pedestrians and vehicles at highway intersections to reduce traffic conflicts and improve transportation efficiency and safety.

Congestion is a situation or condition of stagnation or stopping of traffic caused by the large number of vehicles exceeding road capacity (Isradi, Nareswari, Rifai, & Prasetijo, 2021). traffic congestion has become a significant problem in the field of transportation (Zeng, Wang, Li, Jiang, & Doss, 2020). An efficient and intelligent road traffic management system is the cornerstone of every smart city (Sathiyaraj & Bharathi, 2020). This system has been in use since the late 19th century and continues to change in terms of technology and regulatory techniques. More intelligent and more responsive traffic management systems are needed as cities grow, and the number of vehicles increases. Often, conventional traffic light systems with fixed time cycles are inadequate to cope with congestion at any given time, especially in large cities with frequently changing traffic.

Traffic jams not only cause extra delays and stress for drivers but also increase fuel consumption and air pollution (Gandhi, Solanki, Daptardar, & Baloorkar, 2020). Accidents between vehicles often occur at intersections with traffic lights (Kee & Bashi, 2021). Traffic is a global problem (Wincent, Rifai, & Isradi, 2022). This has prompted the development of various advanced technologies in traffic light systems, such as the use of sensors, AI algorithms, and Internet of Things (IoT) connectivity.

2.2 Development of Traffic Light Technology

Traffic lights have been used for decades to control and manage traffic flow across intersections to improve traffic efficiency and road safety (Aleko & Djahel, 2020). In the last twenty years, there has been a great emphasis on road safety due to the increasing number of drivers on the road. Safety will remain the number one priority, and for this reason, any positive change or technological change will be welcomed by the government and vehicle manufacturers (Purnama, Rifai, & Nasrun, 2022). Thus, adaptive traffic signals that are capable of monitoring are needed to control traffic light signals based on traffic density (Palša, Vokorokos, Chovancová, & Chovanec, 2019). Many systems today use sensor-

based traffic lights that can detect the number of vehicles and change the duration of the lights in real time.

Road infrastructure is very important for the development of the economy and human mobility throughout the world (Reta, Rifai, Taufik, & Prasetijo, 2024). The development of highway construction is increasing rapidly In Indonesia, along with the rapid use of private vehicles (Meng, Damanhuri, & Othman, 2021). Traffic congestion is a problem on street networks that happens as automobiles upsurge. This problem is categorized by slower speeds, longer trip times, and increased vehicular queuing. It affects the economic growth of a country, increases accidents, increases resource costs, and causes environmental pollution (Albatish & Abu-Naser, 2019). This sensor-based technology uses inductive sensors embedded in the road, cameras, and infrared detectors. Sensor-based traffic light systems can reduce waiting times by up to twenty per cent compared to conventional traffic light systems. However, with the increasing number of public (bus) and private vehicles (cars, motorcycles, and trucks), the city centre is becoming increasingly densely populated. Such phenomena cause traffic jams and increase environmental pollution and noise (De Oliveira, Manera, & Da Luz, 2020).

This has led to increased traffic volume and the potential for accidents at the Cigasong roundabout (Rifai & Aulia, 2019). Traffic volumes can be estimated with a few observation points. Additionally (Ellappan, Sindhusaranya, & Hailu, 2019), the incorporation of sensors with artificial intelligence allows traffic light systems to predict traffic patterns to optimize vehicle flow. Although intelligent traffic light systems have many advantages, there are some problems when using them. One of them is the high cost of installation and maintenance, especially when installing sensors, cameras, and other supporting devices.

2.3 The Effect of Traffic Lights on Traffic Safety and Comfort

Road damage occurring in various countries, including cracks, potholes, and surface deformation, signi ficantly impacts transportation safety and efficiency (Kharisma, Rifai, Taufik, & Prasetijo, 2024). Cities are increasingly concerned about urban traffic congestion and its associated negative externalities. Indeed, road congestion is considered an urgent and growing challenge for sustainable mobility, transport policy, and urban governance (Albalate & Fageda, 2019). Traffic lights are essential to improve safety on accident-prone highways; adding traffic lights in accident-prone locations can reduce the number of incidents by up to 40%.

Presently, most smart cities face massive traffic issues every day (Liu & Ke, 2023). The existing fixed traffic light control system divides the traffic light signal into fixed duration and runs in an inefficient manner. Therefore, it suffers from many disadvantages, such as long waiting times and fuel waste (Kumar, Rahman, & Dhakad, 2020). In addition, several studies have shown that adequate traffic light settings can reduce pollution produced by vehicles stuck at intersections. Adaptive and sensor-based traffic light systems improve traffic efficiency and reduce travel time. This prevents congestion, which can increase fuel consumption and carbon emissions, especially in urban areas with high vehicle density.

In general, road users in Majalengka tend to use high speeds (Sumantri, Rifai, & Ferial, 2022). The traffic situation at an urban intersection is complicated due to the numerous internal conflicts and traffic accidents (Hu, Ou, Huang, Chen, & Cao, 2020). With the continuous population growth, traffic congestion has become one of the biggest obstacles restricting the city's economic development; it results in high consumption of fuel, increases the cost of commutes, and also pollutes the environment (Lee & Chiu, 2020). This information can be an important basis for traffic light repair and maintenance to improve comfort and safety for all road users (Nurhasanah, Rifai, Taufik, & Isradi, 2024).

3. Techniques

This study techniques used the current questionnaire techniques. The questionnaire method is a set of written questions for respondents to answer. Respondents' answers are then collected and analyzed to obtain the information needed. This data is collected by asking everyone who has passed through the cigasong roundabout questions.

The Cigasong Roundabout is a roundabout located in the Majalengka district which connects the road between the Cigasong Road and Majalengka City, precisely on K H Abdul Halim Road; many comments from road users because some time ago, the traffic lights in the area did not work and could cause accidents, Figure shows the research location.

Figure 1. Research site

4. Result and Discussion

4.1 Respondent's Information

The data collected from the respondents were divided based on gender, age, and the vehicle used when passing through the Cigasong Roundabout. The results show that all respondents have passed through the Cigasong Roundabout, with the majority being male and the majority aged between >20 years and 21 years - 30 years. The most frequently used vehicle is a motorcycle, the least frequently used vehicle is a car, and the least frequent age of road users is between 41 and 50 years old.

Table 1. Respondent's Information

Variabel	Categori	Frequency	Percent
It crosses the	Once	25	100%
	Never	-	
Gender	Male	21	42%
	Female	4	8%
Age	≤20	12	24%
	21 - 30	12	24%
	31 - 40	0	0%
	41 - 50	1	2%
	51 - 60	0	0%

4.2 The Importance and Level of Satisfaction of Road Lighting

Data is required from two respondents, who are frequent road users. One assessment theory in the management of questionnaire data is confidence, which is a grouping based on quality. Using this theory, the research was able to categorize the questionnaire results based on the type of questionnaire questions and based on the assessment results of road users using this research questionnaire. Table 1 shows the data processing instrument designed to assess road users' significance of and contentment with the lighting at Bunderan Cigasong.

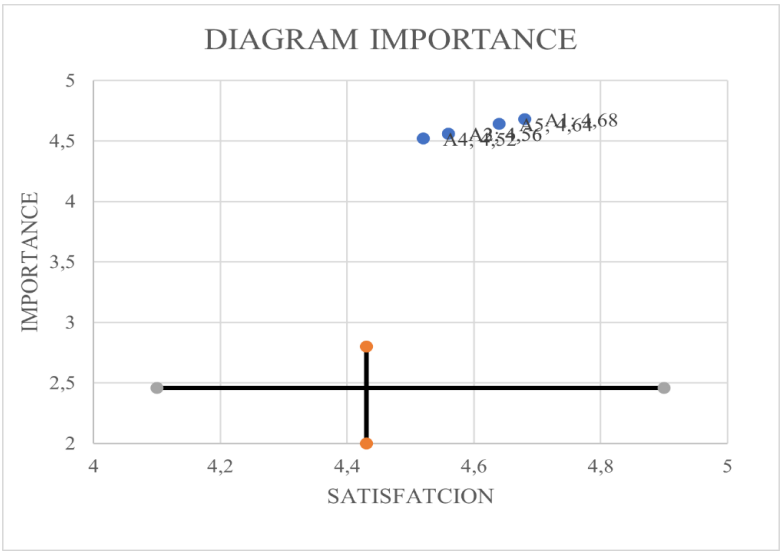
Table 1.1 Level of importance and satisfaction

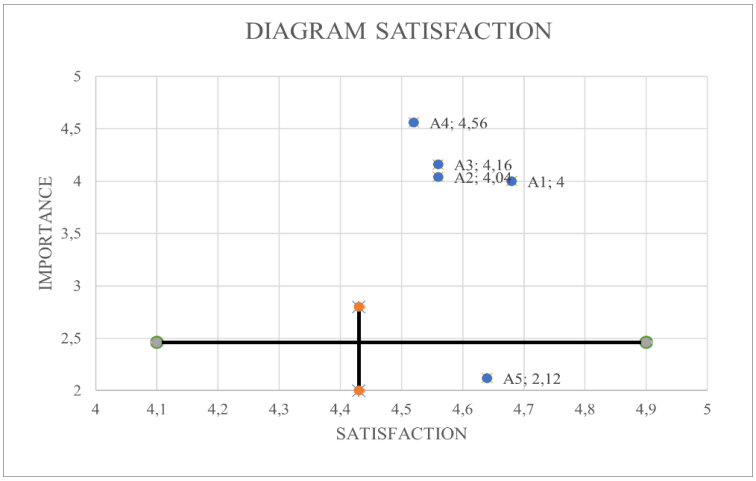
Dimensi Servqual	Indicator
Assurance	How important are road traffic lights and traffic signs for safe driving?
	How important are road traffic signs for safe and comfortable driving?
	How important are traffic signs on this road?
	How important are traffic signs for reducing the risk of road accidents?
	How important are traffic signs for activities other than driving?
	How satisfied are you with the availability of traffic signs on this road?
	How satisfied are you with the traffic signs on this road for safe driving?
	How satisfied are you with the traffic signs on this road for safe and comfortable driving?
	How satisfied are you with the traffic signs on this road for activities other than driving?
	How satisfied are you using traffic indications of this road to lower the danger tragedies?

This questionnaire measures indicators based on the dimensions of information quality for each variable. In addition, this questionnaire data was evaluated based on the significance and degree of contentment with the traffic signs at Bunderan Cigasong. It is expected that, in this way, it will be easier to process the data before proceeding to the next stage.

NO	Indicator	Indicator	Average Importance	Average Satisfaction	Difference
A1	How important are traffic signs for safe driving?	How satisfied are you with the availability of traffic signs on this road?	4,68	4	-0,68
A2	How important are road traffic signs for safe and comfortable driving?	How satisfied are you with the traffic signs on this road for safe driving?	4,56	4,04	-0,52
A3	How important are traffic signs on this road?	How satisfied are you with the traffic signs on this road for safe and comfortable driving?	4,56	4,16	-0,4
A4	How important are traffic signs to reduce the risk of road accidents?	How satisfied are you with the traffic signs on this road for activities other than driving?	4,52	4,56	0,04
A5	How important are traffic signs for activities other than driving?	How satisfied are you using traffic indications of this route to lessen the risk tragedies?	4,64	2,12	-2,52

Importance Performance Analysis (IPA)





The table above shows the level of satisfaction and importance for each quadrant. Quadrants I and II show a very high level of satisfaction and are very important to maintain; Quadrant III shows an equally

high level of satisfaction but with lower importance; and Quadrant IV shows a very high level of satisfaction and paramount importance.

Conclusion

The results show that the average value of the level of importance of traffic signs is 4.59. However, the level of satisfaction with traffic signs reaches an average of 3.78; there is a gap between importance and satisfaction of -0.816; the minus value indicates that the level of satisfaction must be increased again to achieve a balance between importance and satisfaction with these road users. Furthermore, the parameter that is considered most important is traffic signs for driving safety. The highest satisfaction is given to traffic signs on this road for activities other than driving. The lowest level of satisfaction is traffic signs on this road to reduce the risk of accidents.

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