MEASURING THE SPEED COMPLIANCE IN UNIVERSITY CAMPUS- A CASE STUDY AT UTAR KAMPAR

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ABSTRACT

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The research examines speed compliance of vehicles at the Universiti Tunku Abdul Rahman (UTAR) Kampar campus by studying straight roads and curved roads as well as parking zones. The research project examines both the level of speed limit compliance among campus vehicles and the zones where speeding occurs most frequently, and it assesses existing speed reduction methods. The researchers conducted mechanical speed measurements with radar guns at 16 checkpoints during four time periods of each day. The majority of vehicles do not follow speed restrictions as results show main roads having average speeds above 30 km/h and parking areas exceeding 15 km/h. During peak traffic times the rate of speed compliance gets higher since drivers display more caution on busy roads. The research results indicate that campus road security requires better enforcement efforts together with educational initiatives and structural enhancements including better signage along with extra speed reduction features. The research provides essential information which campus authorities should use to develop targeted plans to enhance safer driving practices and protect campus users.

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Finally, we would like to thank **UTAR Kampar** campus for giving us this platform to conduct this research project. Last but not least, our sincere appreciation for all the individuals and frends who have helped us throughout this research project.

DECLARATION

I hereby declare that the dissertation is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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APPROVAL SHEET

This research project entitled "**MEASURING THE SPEED COMPLIANCE IN UNIVERSITY CAMPUS - A CASE STUDY AT UTAR KAMPAR**" was prepared by CHEE HE WID, SALAMON A/L BRANGISS, SIM ZHENG LIN and SIN YI YANG and submitted as partial fulfillment of the requirements for the degree of Bachelor of Science (Hons) Logistics and International Shipping at Universiti Tunku Abdul Rahman.

Approved by:

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Date: 25/4/2025
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PERMISSION SHEET

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UNIVERSITI TUNKU ABDUL RAHMAN

Date: 25/4/2025

SUBMISSION OF FINAL YEAR PROJECT /DISSERTATION/THESIS

It is hereby certified that CHEE HE WID (ID No: ***21ADB02429***), SALAMON A/L BRANGISS (ID No: ***21ADB03571***), SIM ZHENG LIN (ID No: ***22ADB02110***) and SIN YI YANG (ID No: ***22ADB02095***) has completed this final year project entitled **MEASURING THE SPEED COMPLIANCE IN UNIVERSITY CAMPUS - A CASE STUDY AT UTAR KAMPAR** under the supervision of **Mr Afwan Hakim Bin Md Mahdzir** (Supervisor) from the Department of Physical and Mathematical Science Faculty of Science.

I understand that University will upload softcopy of my final year project in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,

CHEE HE WID	SALAMON A/L BRANGISS	SIM ZHENG LIN	SIN YI YANG

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Chapter 1 Introduction

1.1 Introduction

In this modern world, owning a type of vehicle is becoming more common nowadays. This makes the room for accidents or traffics violations to occur. According to WHO (World Health Organisation), there are almost 1.19 million people that die each year in road traffic accidents and 92% of these accidents occur in low and middle-income countries in the year 2023. (World Health Organization: WHO, 2023) Malaysia is one of the upper-middle income countries. According to the Ministry of Transportation Malaysia, a total number of 567,516 cases of road accidents occurred in the year 2019, and a total number of 6,167 road fatalities have been recorded. (*Ministry of Transport Malaysia*, n.d.) Speed compliance among Malaysian citizens is crucial in preventing accidents, especially in environments on university campuses.

UTAR is a higher studies institution and serves as a not-for-profit private university that is known for providing affordable and quality education, with its main campus situated on a 1,300-acre piece of land in Kampar. Within this extensive campus, many roads are made accessible to both students and staff, who frequently cycle and drive to classes. (*Introduction - Universiti Tunku Abdul Rahman*, n.d.) Straight roads, often encourage higher speeds, due to their unobstructed nature which will raise the potential chance of traffic accidents. The purpose of this research project is to investigate the speed compliance of vehicles inside of Universiti Tunku Abdul Rahman (UTAR) Kampar campus, with a primary focus on straight roads, curvy roads, and also parking zones. According to Hussain et al. (2019), excessive speed is the main contributory factor in vehicle crashes.

High travel speed significantly increases the risk of crashes and the severity of injuries in the event of a collision, particularly on roads designed for higher speeds. (Hu & Cicchino, 2019) The awareness and adherence to traffic rules both institutional and national, are essential for safeguarding the university students from severe fatalities and to create a sustainable smooth traffic scenario. (Dawood et al., 2022) That is why speed compliance is important. Overall, this research is purposed to examine the speed compliance of vehicles operated by students and staff within the university to provide insights that could inform and enhance the institution's traffic management strategies especially speed management on campus. The ultimate objective of this research is to contribute to creating safer and more favourable conditions for all campus road users in the world.

1.2 Background of Study

The increasing number of people and vehicles on the road nowadays, driven by economic expansion, has raised the likelihood of accidents. This gives teens more opportunities to purchase a car because it makes traveling around

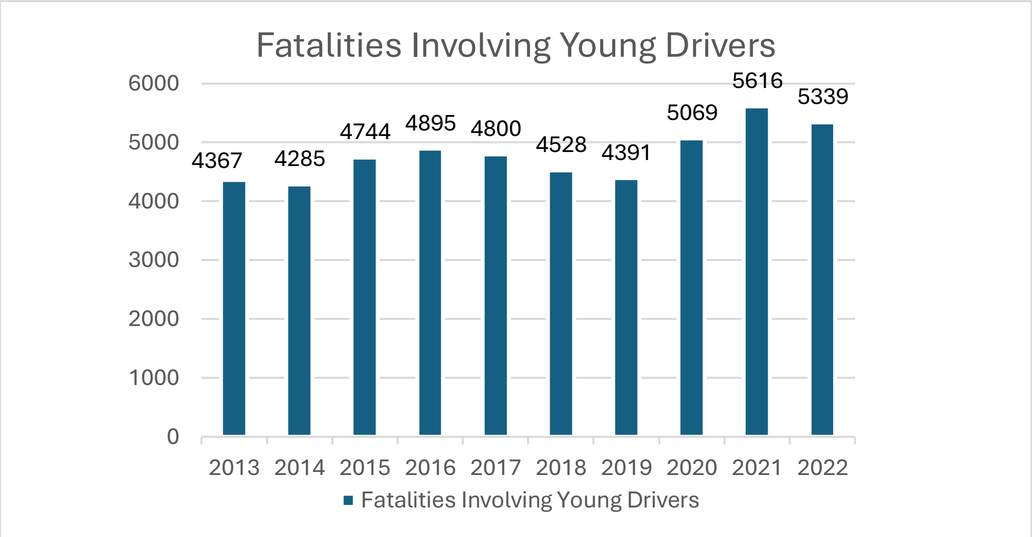
Malaysia easier, especially for college students who recently obtained their driver's license but still lack proper driving experience. The fatality rate is typically examined in proportion to the population or the total number of registered cars in the studied area in traffic fatality rate studies. (Abdelfatah, 2016)

Besides being a global pandemic, killing over a million people every year, road traffic accidents have also become one of the most publicly highlighted issues in most countries. In this context, Abidin et al. state, "Since the end of World War II, more than 30,000 people die due to a motor vehicle every year ". In addition to the suffering of victims and their families, crash-related deaths and injuries cost the general public and individuals more than $340 billion annually in medical costs, lost productivity at work, insurance, legal and other costs. (NATIONAL ACADEMIC, 2024)

According to the World Health Organization, annually road traffic crashes take away an estimated 1.19 million lives. Further, road traffic crashes typically claim the lives of children and young people between the ages of 5 and 29 years of age, and 92% of road deaths worldwide occur in low- and middle-income countries, even though these countries citizens own only around 60% of the world's vehicles. Speed is one of the factors that are involved in causing accidents; increasing average speed has a direct effect on the likelihood of an accident happening and its injury outcome. For instance, with every 1 percent that average speed increases, there is a corresponding increase in the fatality accident chance by 4 percent and the seriousness of having an accident by 3 percent. (WHO, 2023)

National statistics from the United States (NCSA) indicate that from 2013-2022, a total of 48,034 cases occurred in the US. From 2013, the number of fatalities decreased until 2014 but occurred an increase until 2016. Then, it started to drop from 2016-2019, but there was a rapid increase until 2021 and formed the highest peak then started to drop again. According to the data given, the percentage of the age group between 15-20 years was highest which is 53% of the total cases closely followed by the age group 21+ years which is 43% while the age group below 15 years is the lowest part. (NCSA, n.d.) According to this data, the college-age people are the riskiest to have an accident.

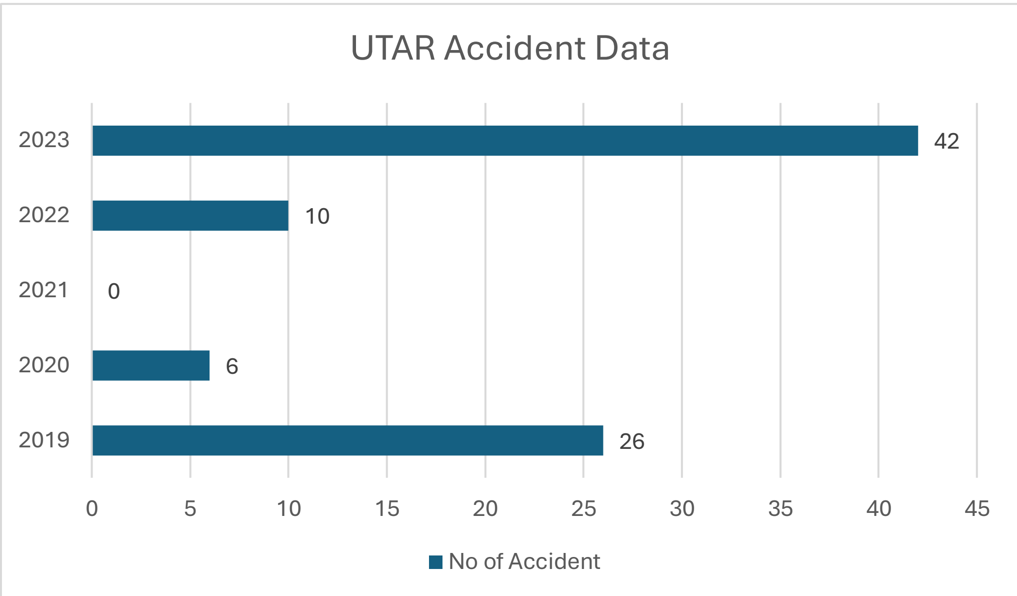
Table 1.2.1: Data of Fatalities involving Young Drivers (NCSA)



Apart from that, UTAR Kampar campus also has a high risk of accidents location as its roads are narrow and curved although there are many bumps in the campus area. Then, according to the data given by UTAR Department of Safety and Security (DSS), there was a continuous decrease from 2019-2021 as fewer students driving around in 2019 as the campus was forced to be closed down in 2020 and 2021 due to the Movement Control Order (MCO) under the Covid-19 Pandemic. Following that, the amount showed an increase in 2022 after the lifting of MCO as UTAR had established a hybrid study mode for students, lecturers, and officers to control the human flow on campus to avoid close contact infection. They can choose either physical mode, study at campus or online mode, study at home through Microsoft Teams. In 2023, UTAR implemented a fully open mode that enables all the students, lecturers, and officers to come back to campus for physical study and operation. So, this caused the amount in 2023 to increase to another peak and it shows that the students should pay more attention while driving a car to avoid accidents.

Table 1.2.2: Accident data in past 5 years

(Department of Safety and Security DSS)



Automobile accidents on the road can happen not just between vehicles, but also between vehicles and pedestrians or even vehicles and cyclists. But since the UTAR Kampar campus is one of the most pedestrian-friendly campuses, road users' safety is very crucial here. Typically, the human components mentioned in Table 1.2 below are causes of accidents. As a result, pedestrians must constantly check their surroundings to ensure their safety because they should not think that the drivers are operating safely. The primary cause of road accidents is the actions of drivers. More precisely, most traffic accidents are caused by speeding and driving in the incorrect lane. (Abdelfatah, 2016) Then, this phenomenon also often occurs on UTAR Kampar campus.

Table 1.2.3: Human factors that affect the likelihood of traffic accident occurrence (Kateřina et al., 2019)

Reduce capability to meet traffic contingencies	
Long term	• Inexperience • Reduction of cognitive and psychomotoric function in relation to higher age
Short term	• Panic reaction • Glare • Health indisposition

	• Drowsiness, fatigue, microsleep • Incorrect evaluation of the situation • Limited view (not caused by heavy traffic) • Mental and somatic handicap • Inattention
Modulate risk taking while driving	
Long term	• Speeding and non-adjustment of driving • Conscious violation of road traffic rules
Short term	• Risky overtaking • The influence of alcohol and psychoactive substances • Suicide

Therefore, it may be necessary to prioritize speed compliance on UTAR Kampar campus to protect the safety of students, lecturers, and officers, particularly pedestrians. A large signboard and speed bumps will be erected to discourage drivers from exceeding the posted speed limits in university areas, which are 30 km/h on campus roads and 15 km/h in parking zones. Additionally, the bumps may require such drivers to slow down because they may cause unpleasant driving conditions and damage to sections of the car including the suspension, misaligned steering, and tire puncture. (Charalambos et al., 2020) So, the signboards can implement their function, which is to remind drivers of the speed limits and speed bumps in front to reduce the speed. By these measures, the traffic accidents on campus may be reduced and provide a safe traffic environment for road users with the cooperation of individuals. However, the effectiveness of these measures to lower down the vehicle's speed still needs to be verified and approved to ensure the speed of vehicles meets the regulations of Malaysia.

1.3 Problem statement

The main concern is the vehicle's speed compliance on the Universiti Tunku Abdul Rahman (UTAR) campus. The speed limit that is required by the campus is always exceeded and the speed regulations are not frequently followed. Drivers in UTAR engage in risky driving practices as a result of their unwillingness to read traffic signs and their casual disregard for them. Speed compliance is essential to enhancing the safety of the campus community with a large number of people moving around there. But, UTAR didn't adopt appropriate measurements which was unable to prevent violations in speed compliance. This might result in reckless driving and increased community unsafety on campus. Thus, investigating vehicle speed compliance inside the Universiti Tunku Abdul Rahman (UTAR) Kampar campus is necessary with a major focus on straight and curving roadways as well as parking zones.

1.4 Research Objectives

The objective of this study is

1. To identify the percentage of vehicles in UTAR Kampar that complies the speed limit.

2. To compare the speed of vehicles in different zones inside campus.

3. To recognise the ways that are being used to slow down the speed of vehicles inside campus.

1.5 Research Questions

1. What is the percentage of vehicles in UTAR Kampar that complies the speed limit?

2. In which zones do the vehicles tend to speed up more?

3. What are the ways used in the campus to slow vehicles down?

1.6 Significance of Research

This study is deemed to hold significant importance as it studies the implications of speeding inside campus. As maintaining the speed limit inside of the campus is a must to ensure the safeness of vehicles and also pedestrians, this study aims to identify which zones inside of UTAR Kampar are still dangerous zones where vehicles still tend to speed. This research also tends to find out which time frame serves as the most lenient time for vehicles to be speeding and which time frame serves as the best time when vehicles follow the speed limit. Ultimately, this study deems to make campuses a safe place for all by ensuring that all road users obey the speed limit and do not cause any harm to anyone. This research can serve as an aid for the authorities inside the campus to identify the places that need improvement this will help to improve the overall safety in a campus environment. This research can be deemed sustainable as it can serve as a future reference in the cause any measure that might be taken to mitigate the risk of over speeding in campus.

Chapter 2 Literature Review

2.1 General Speed Limit

Due to increased vehicle traffic, the government has to implement a policy that restricts the number of vehicles on the road for safety. The purpose of a speed limit is mainly to limit users from being able to maintain comfortable and safe environments while driving. By offering directives on the right speed that a driver should follow, this sign contributes to effective speed management by implying that a certain class of roadways has a legally prescribed maximum speed at which automobiles are permitted to drive. It is important to note, however, that the speed limit imposed is an upper limit and does not imply that driving at that speed under all conditions is safe. Because of this, a driver must carefully consider the ideal speed to assume if the conditions of the road, the vehicle, the man, and the weather do not fall within the range of perfect characteristics. (Dario et al., 2019) For this reason, it is worth mentioning that speed limits are determined by the government. These are all different from nation to nation, area to area, and type of road but have been always considered taking ideal daytime visibility, with clear pavement, lacking fog, rain, snow, or frost. (Zolali et al., 2021) However, those exceeding the permitted limit by a larger margin will lead to an accident on the road. (Lee et al., 2020) Road safety is aimed to be enhanced by reducing the accident risks and maintaining smooth traffic flow, thus ensuring that the driving climate is predictable.

In addition, the Road Transport Department (JPJ) implemented a signboard at the side of the road and painted the speed limit on the road to boost the speed limit's conspicuousness. Given that it is easy to notice while driving, this may offer advice to the driver as it should above all aid the driver’s perception, facilitating the correct interpretation and evaluation of the layout and conditions of the route, to limit adverse driving events. (Dario et al., 2019) Nevertheless, increasing the size of the speed limit sign and positioning it on the road may heighten drivers' perception of its significance when determining the safest speed to drive, even if they always observe the signs. (Lee et al., 2020)

Furthermore, roads such as highways, federal, state, and municipal roads in Malaysia are subject to the implementation of the National Speed Limit Order 1989 thanks to the Road Transport Act 1987 along with the Motor Vehicles (Speed Limit) Rules of 1989, which forbids any vehicles from going faster than the allowed speed limit on roads. The National Speed Limit Order 1989 sets the speed limits for other roads and highways at 90 km/h and 110 km/h, respectively. Highways in rural areas are subject to speed limitations of 110 km/h, whereas urban highways are subject to limits of either 90 km/h or 80 km/h, contingent upon the nature of development in the vicinity, particularly in places with steep inclines and crosswinds. The speed limit on other kinds of roadways, such as state and federal highways, ranges from 30 to 90 km/h. Most major towns across the states are connected by federal roads, most of which have speed limits of 90 km/h. State routes have 80 km/h speed restrictions in the meantime. (Rashid et al., 2021) The speed restrictions are lower in more populous regions: 30 km/h near schools, 40 to 50 km/h in residential zones, and 60 km/h in the town area. (Md et al., 2013) In addition, the speed limit for large vehicles was modified to 80 km/h on expressways and 70 km/h on federal and state highways. (Hashim et al., 2016)

In addition to the hierarchy of functions for roads, the type of vehicle also affects speed limits. There are many kinds of traction vehicles used on roads, depending on whether or not the National Speed Limit Order 1989 declares the route. 24 categories are produced as a result, with speed limitations ranging from 20 to 110 km/h. Furthermore, the Minister of Works, State Governments, the

Director-General of the Malaysian Highway Authority, and Local Governments are empowered by the Road Transport Act 1987 to establish speed restrictions within their respective jurisdictions using an order that is published in the Gazette. The National Speed Limit Order of 1989's limitations, however, must not be exceeded by the limits. Speed restrictions are often displayed by the roadside and are subject to change based on the environment and traffic patterns. (Rashid et al., 2021)

Table 2.1.1: Speed Limits based on vehicle class and the type of roads in Malaysia (National Speed Limit Order 1989)

	Class of Vehicle	Maximum Speed	
		Roads described in the National Speed Limit Order 1989	Other Roads
1	Motor vehicle with pneumatic tires on all wheels:		
	a. Passenger vehicles -		
	i) Having a seating capacity up to 12 persons including driver and used for hire or reward	110	90

	ii) Having a seating capacity up to 12 persons including driver	90	80
	iii) When drawing a trailer	80	70
	iv) Motor van	90	80
	b. Goods vehicles (rigid or articulated-		
	i) Without a trailer or semi-trailer with maximum permissible laden weight not exceeding 7,500 kg	90	80
	ii) Without a trailer or semi-trailer with maximum permissible laden weight exceeding 7,500 kg	80	70
	iii) When drawing a trailer or semi-trailer, excluding a trailer drawn by a land tractor	80	70
	iv) 3 wheelers including motorcycle with side cars	70	60
	c. Recovery trucks, mobile cranes and other mobile machinery, vehicles drawing	80	70

	mobile machinery trailers or semi-trailers		
	d. Land tractors with or without a trailer	50	40
2	Motor vehicles fitted with solid rubber tires	Half the speed specific in paragraph 1	Half the speed specific in paragraph 1
3	Motor vehicles not fitted with either pneumatic tires or with solid rubber tires	20	20

Figure 2.1.1: Bump-signage found inside of UTAR Kampar campus

Figure 2.1.2: Speed signage found inside of UTAR Kampar campus

The pictures above show the speed signages found inside of UTAR Kampar campus that serve as a guideline for road users to follow when they are inside of the campus. According to Table 2.1.2, the report of the Ministry of Transport Malaysia, there was a continuous increase from 2010 to 2019 as the number of registered vehicles in Malaysia had also continuously increased according to Table 2.1.3, the report of CEIC Data. It had an increase of about 157% from 2010 to 2019 which shows that the road users have become more, and the risk of an accident is higher.

Table 2.1.2: Statistic data of road traffic accident (Ministry of Transport Malaysia)

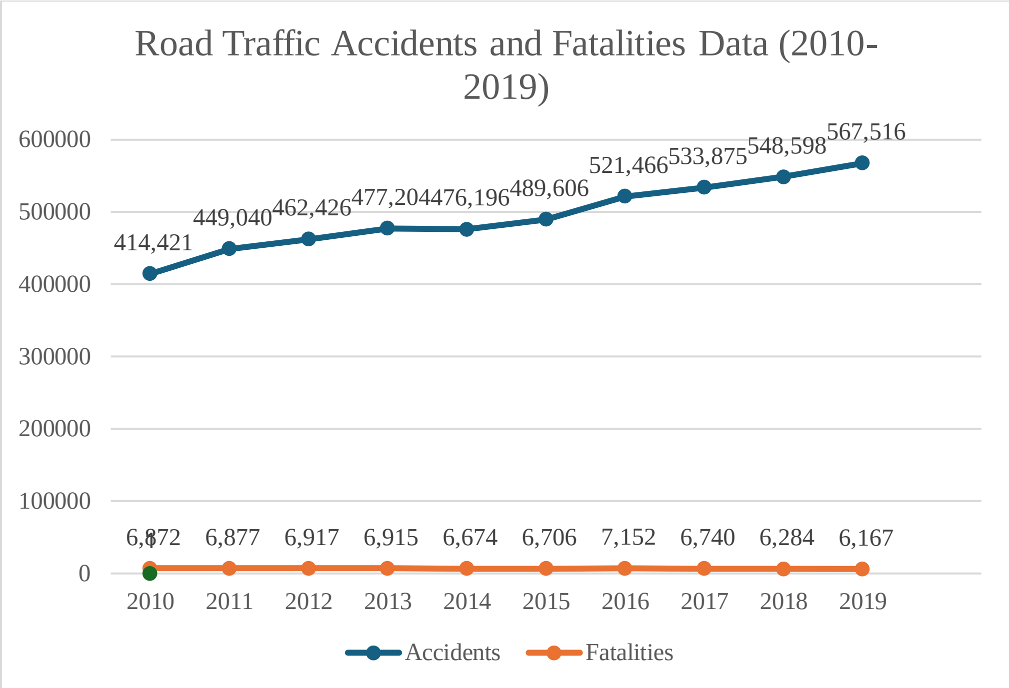
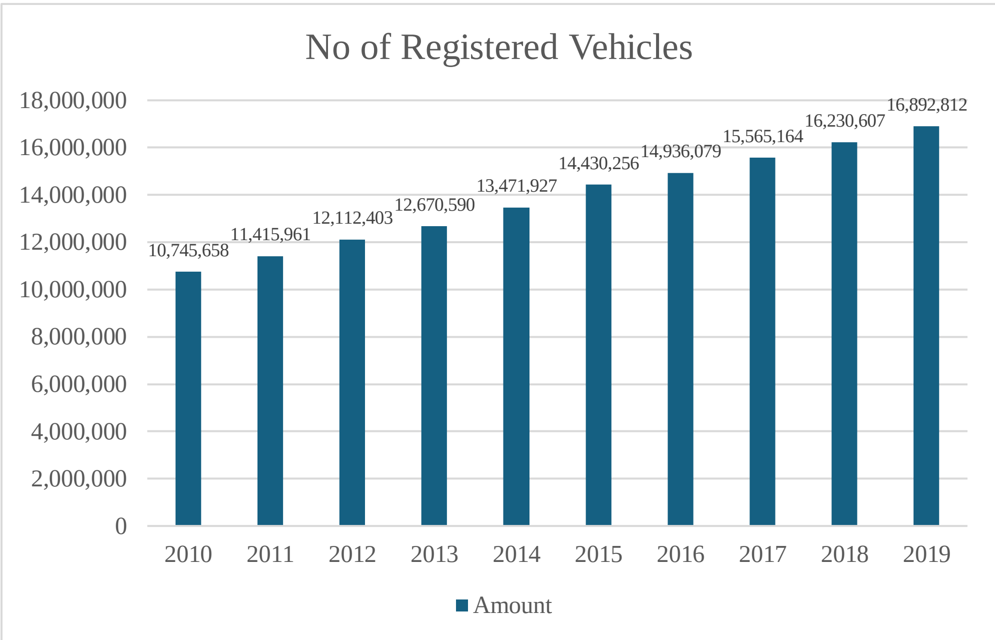


Table 2.1.3: Data of registered vehicles (CEIC Data)



To ensure the safety of locals and other road users, the Malaysian government must tighten its enforcement of driving behaviour control laws in order to reduce the number of accidents. (Rahim et al., 2020)

Regarding the enforcement procedures in Malaysia, driving at a speed which is higher than the stated speed limit for a particular class of vehicle will be deemed as a crime under the Road Transport Act 1987 for any drivers. According to section 69(1A) of the act, a driver will be punished by being fined a compound up to RM300 if the person is suspected as an offender. If the payment is not being made, the fine is still in effect until a legal measure is taken, usually by giving a notice to the motorist to show up to the closest magistrate. Following that, the demerit system will be implemented, where drivers who meet, specific limit will risk having their driver's licenses revoked. (LAW OF MALAYSIA 2013)

The Road Transport Department (JPJ) and the Royal Police Malaysia (PDRM) are the enforcement authorities in Malaysia that handle speeding violations. The first step in enforcing speed laws is measuring the speed at specific times and places using approved speed detectors. The location and time are determined by looking at crash data that indicates a high frequency of speeding. The tickets are either given to the violators or posted to the address of the vehicle owner whenever an enforcement action is combined with a roadblock further down the road. (Rashid et al., 2021)

Additionally, PDRM has been conducting "Ops Sikap" road safety enforcement operations since 2001 to foresee the volume of injuries that may occur during festival seasons. Its goal is to improve adherence to traffic safety laws and regulations on the roads. Later, to their responsibilities, a few more government departments, including the Road Transport Department (JPJ), the Public Works Department (JKR), and the Road Safety Department (JKJR), joined the enforcement activities. These combined operations, known as "Ops Bersepadu," have been conducted since 2006 to step up enforcement throughout the holiday seasons. Up until 2012, the police carried out Ops Sikap; starting in 2012, they went by the name "Ops Selamat." Following that, these enforcement actions were viewed as successful since they had improved traffic safety over the holiday seasons over time, particularly in terms of lowering the number of injuries. (Darma et al., 2021)

Finally, since different countries have distinct policies, speed limits may vary. For instance, there are sections of the Autobahn in Germany with no posted speed limit, while in other nations, such as China and Poland, the maximum speed allowed is up to 120km/h and 140km/h. As a result, speed limits will be set by their nation and authorities based on factors including traffic volume, road conditions, and safety.

2.2 Youngsters' Adherence to speed limit

Compared to other age groups, teenage drivers have the highest probability of being involved in an accident. For instance, in the US, adolescent drivers make up just around 5% of licensed drivers, but they are responsible for a disproportionate percentage of fatal collisions. According to one of the first studies on sleep driving accidents, most of them occurred in North Carolina and included people under the age of 25 (Foss, 2019). Other than that, we can find that reducing speeding was the most often reported behavioural improvement among teens, according to the discussion of (Mims, 2020). According to data from three-month longitudinal research, speeding accounts for almost 43% of fatal accidents involving young drivers, compared to 23% for elder drivers. Even though speeding carries a danger, 28% of youth report receiving a speeding ticket during the previous year.

Additionally, it has been discovered that the attitudes and subjective norms of young drivers strongly influence their speeding—that is, they are exceeding the speed limit by more than 10 km/h. Research that self-descriptions, attitude, descriptive norms, perceived similarity, and perceived are statistically significant predictors of speeding intention, regardless of the driver's prior behaviour (Guggenheim, 2020). Lack of sensitivity to punishment greatly reduces risk-taking in young people, impulsivity and sensitivity to reward significantly enhance the perceived danger of engaging in a behaviour that strongly impacts the intention of young drivers to do so (Geber et al., 2017). This age group's demand for a sense of power, self-esteem, and social recognition is met by the risk-taking mindset generally and when driving in particular. This is often tied to gender roles. Especially for shared social activities, like driving with friends, where driving rules are shaped by the social discourse that is common in their age group. Young drivers may speed out of a desire for social acceptance, particularly if they think it would make their peers respect or like them. For instance, teenage drivers could be more likely to speed if they believe that doing so will help them fit in or elevate their standing among peers (Sullivan et al., 2021).

Similarly, social support or pressure is thought to have a significant role in the problematic driving behaviours of teenagers including risk-taking and potential for resistance, and this effect is amplified when friends are in the vehicle. For example, behaviours such as excessive speed, drinking and driving, and ignoring traffic rules is considered something to be proud of and it is encouraged among peers (Rodwell et al., 2023). Peer pressure affects young drivers especially those who just took their license. They are more inclined to follow the norms if their friends and social circles support speeding or other unsafe driving behaviours. It is also safe to say that men’s natural tendency towards competition will result in a desire to be noticed by others and to attain greater prestige for showing how impressive they are. For example, young individuals who drive with male passengers on the weekends are nonetheless at risk for accidents because of the peer pressure that encourages aggressive, careless, and dangerous driving (Padilla et al., 2023). According to (Guggenheim, 2020), teenage drivers are more inclined to speed while driving if they find that their friends also have the same habit of speeding, or they want to prove a point among their friends that they are the best.

Compared to female drivers of the same age, young male drivers are more likely to be engaged in higher-speed collisions, which frequently result in the automobile leaving the road. It has been discovered that young male drivers who distinguish between mood, emotion, and attitude express considerably higher delight in engaging in unsafe driving conduct (Rhodes, 2015). The relationship between testosterone and taking risks is also covered, as puberty, particularly in males, is associated with major hormonal changes. As a result, a lot of people believe that this hormone and men's propensity for taking risks (Forward, 2020).

On the other hand, prior research has demonstrated that delivering feedback generated by in-car data recorders to parents of young drivers can lower the frequency of unsafe behaviour. For instance, some youth engaging in unsafe driving behaviour would be linked to better-perceived family dynamics and lower levels of sensation seeking, anxiety, and aggression among parents.

According to the study, teenagers who drove with their parents or had their driving observed by telematics, or who had greater degrees of parental supervision, were less likely to speed. Adherence to speed limits was more successfully encouraged by parents who actively observed their teenagers' driving behaviours and gave immediate comments (Taubman, 2015).

According to preliminary statistics from 2020, there was a rise in the percentage of speed-related deaths in the early months of the COVID outbreak because there was less traffic on the roads and less law enforcement involvement. Research (Jang et al., 2024) show there are over 400,000 teenage drivers (ages 15 to 19) are registered in the state of Florida; these drivers have been involved in 60,135 collisions, which have resulted in 279 traffic fatalities and 2,200 serious injuries. In this instance, it appears that the majority of young people were breaking rules and regulations because of less adequate attention from the authorities (Peterson, 2021). Personal values and views toward authority and rules may have an impact on attitudes. A Young motorist may be more prone to breaking speed restrictions if they believe that traffic regulations are arbitrary or meaningless. Other than that, drivers have more options for action when traffic congestion is unusually low during the pandemic; how they respond to these altered circumstances may rely on a variety of social and motivational variables. For instance, Reduced traffic volume may make drivers more relieved, which might lead to them speeding more or engaging in other risky behaviours as a coping mechanism (Tucker, & Marsh, 2021).

Crash hour is another term for the period when driving at night without an adult's supervision was considered dangerous, particularly from 10 p.m. to 1 a.m. With or without passengers, teen drivers frequently participate in dangerous driving behaviours at night such as inattentive driving, drinking, and driving, or infractions on the road. It also asserted that teens had an increased risk of injury between the hours of 12 and 6 a.m. Increasing aggressive tendencies of drivers under the influence may engage in more reckless behaviours, including speeding, to express frustration or assertiveness on the road. Besides, the factor of alcohol consumption is also involved by associated with overconfidence in one's driving abilities. This inflated sense of control can lead to higher speeds as drivers believe they can handle the vehicle safely despite their impaired state (Hossain, & Rahman, 2023).In conclusion, encouraging road safety and lowering the number of traffic-related events depends greatly on young drivers adhering to speed limits. Studies and empirical evidence repeatedly demonstrate that inexperience, overconfidence, and peer pressure are among the main reasons why younger drivers frequently struggle to adhere to speed restrictions. For example, research suggests that younger drivers are more prone than older, more seasoned drivers to speed, which raises the risk of accidents for this demographic.

2.3 Preventive actions to reduce speed

As all of us are aware, speed can cause harm in many ways. According to Ledesma et al. (2024), excessive speeding can be considered as a major risk for serious injuries and fatality too. Road accidents are one of the most common implications that will happen when people are speeding but do not know how to control their vehicles. In 2023, Malaysia's traffic accident number was at 598,635 which is a very high number and speeding is one of the common reasons why these accidents occur. While some may only get bruises or injuries from accidents, some lose their lives. Death tolls caused by accidents were nearing 12,000 in 2022 which was an alarming rate.

According to (2024) apart from speeding, the other causes of traffic accidents include human factors such as driving under the influence, not paying attention when driving (using a mobile phone when driving, not being alert of the surroundings, and more), age factor driving experiences. Apart from human behaviors, factors such as poor road conditions and vehicle problems also can cause accidents to occur. According to Jamali-Dolatabad et al. (2024) sometimes accidents do not occur only because of one factor they may be caused because of multiple factors such as human factors and poor weather conditions. However, since the main concern is about speeding, more research about speeding will be done. But these other factors should not be ignored when taking necessary steps to prevent accidents.

2.3.1 Fines and Penalties

The next part will be about what actions that are being taken to reduce speeding on the road. Generally, there are few steps which are taken to control the action of people driving dangerously fast. The first one will be imposing a fine on the wrongdoers. JPJ Malaysia has stated a guideline on the fines that will be imposed for speeding. The fines vary in 3 ways. According to the JPJ Portal, the first one is a fine of RM150, the second one is a fine of RM300, and the third one is issuing a court order which means the wrongdoers need to present to court to be trailed and given a verdict. The below table shows the three ways more clearly.

Table 2.3.1: Fines according to the speeding violences

Offences	Day 1-15	Day 16-30	>Day 31
Speeding not more than 40km/h over the speed limit (Private vehicles)	RM150	RM200	RM300
Speeding more than 40km/h over the speed limit (Private vehicles)	RM300	RM300	RM300
Public service vehicles driving above speed limit of 80km/h or 110km/h	GO TO COURT	-	-
Employee transport vehicles driving over 80km/h or 110km/h	GO TO COURT	-	-

These steps serve as the necessary actions that need to be taken to make road users to follow the law and be scared of breaking the law.

2.3.2 Traffic Calming Methods

Rather than fines and penalties, the other methods will be using traffic calming methods. According to Lee et al. (2013), traffic calming methods have successfully made drivers in cities behave much better toward safety The second step that is normally used to reduce speed in certain areas is by having speed bumps and raised platforms. These bumps make cars go slow over them no matter what as by going over the bump, the drivers might damage their vehicles. According to Penny and Penny (2023), speed humps can reduce the average speed of vehicles by 20%-25% which is quite effective considering not having anything to reduce speeds.

Figure 2.3.1: Speed bump in UTAR Kampar campus

Other than these two steps, another speed-calming method will be creating rumble strips which allow the car to slow down because of the vibration being produced by the strips. This method is commonly used in urban roads and schooling areas. Rumbling strips are also used as a method to reduce speed on curvy roads. This is because the vibrations and sounds that come out when a driver goes over a rumble strip will make them slow down their car. This is also a very effective method during nighttime as drivers who are not alert or sleepy while driving will quickly get focused (Marizwan, 2019) and this will avoid the chances of them getting into a car accident. In Malaysia, generally, rumble strips will be yellow and it is easily identifiable from far away.

Figure 2.3.2: Rumble strips in UTAR Kampar campus

From a different perspective, vehicle technological advancement also can be used to reduce speed driving. This can be done through Intelligent Speed Assistance (ISA). ISA allows vehicles to send warning signals to drivers when they are driving above the speed limit. The signal varies from showing signals on the dashboard, vibrating the steering wheel, or even making some noise. (*All Eyes on ISA: Speed-limiting Technology Is Here to Stay*, 2024). This technology is a great thing for drivers, especially the old ones as sometimes they might not be aware of the speed limit or be less alert to the surroundings. Apart from this, according to Garsten (2024), all the vehicles that are being sold in Europe from July 2024 onwards are deemed mandatory to have ISA equipped in the car. This is a very effective move taken by the European government which enhances safety during driving.

2.3.3 Tracking Down the wrong doers

As an aid to track down the wrongdoers who break the law regarding speeding, there are a few detection systems that we can use. The most common way is using speed detection cameras. Speed detection cameras can be used in both freeways/expressways or even urban roads which are at traffic light areas. Speed detection cameras integrate the technology from Radio Detection and Ranging (RADAR), Laser Infrared Detection and Ranging technology, and camera. The RADAR detectors use radio waves to detect vehicles coming via the antennas of the vehicles and the transmitter inside of the RADAR detector helps to detect the speed of the car using the Doppler shift method. (Smith,2019). The Doppler shift effect is a relationship between the frequency of waves received with the natural frequency of waves. This helps to calculate the speed of objects just by using the frequency of waves and the time of the waves. This helps to get accurate data on the vehicles such as speed, vehicle number plate, and much more. (Nur Adila Binti Mamat, 2012).

Apart from that, Nur Adila Binti Mamat (2012), also states that the price of a speed camera ranges from RM10,000 to almost RM15,000. But the advantage of this type of speed camera is that the fact that police officers or other law enforcement officers will not need to be hiding/standing by the roadside or behind the signboard while holding a speed detection gun. This is not only considered a hassle for the people involved, but this also serves as a safety hazard for them as staying by the roadside can be dangerous as they will be more prone to accidents or getting hit by a road user. Hence, these automated speed detection cameras are much better even though they are expensive.

In the context of Malaysia, currently, the common speed detection systems that are being used are Automated Enforcement Systems (AES) traffic light cameras and also speed guns. According to the Road Transport Department of Malaysia (JPJ), there are a total of 566 AES cameras on the freeways/express while 265 traffic light cameras have been set up. Apart from the AES, Malaysia is setting up a new speed detection system which is the Automated Awareness Safety System (AWAS) which uses a different setup compared to the AES. The AWAS uses a modular setup called The Ekin Spotter, which is equipped with technologies such as audio speakers, Wi-Fi hotspots, and beacon lighting also the cameras are high resolution and capable of monitoring large and wide areas. (Chan, 2024)

Figure 2.3.3: AWAS Camera in Malaysia (Chan, 2024)

Figure 2.3.4: AES Camera in Malaysia (Tan, 2023)

2.4 Speed Limits, Preventive Measures and Consequences in context of university campuses.

University campuses are special environments where protecting vulnerable groups, including students and professors, who regularly move around campuses, and the need for effective transportation come together. Speed control inside campus limits has therefore emerged as a crucial component of safety protocols on campus. The effectiveness of speed limits, traffic calming strategies, technological interventions, educational campaigns, and their connection with sustainable transportation goals are all examined in this paragraph. The studies offered a thorough grasp of the situation regarding speed limits in academic settings today and shed light on the most effective ways to improve campus safety.

Controlling vehicle speed is one of the cornerstones of campus safety. Speed limits and accident rates are clearly and consistently correlated, according to several studies. For instance, research done by Elvik et al.(2019), showed that reducing speed limits on college campuses significantly lowers the quantity and severity of traffic accidents. Their thorough analysis, which took place on several campuses, revealed a strong correlation between lowering speed limits and a notable drop in accidents, especially in areas with heavy traffic, such as student housing zones and crosswalks. This study draws attention to the direct impact that speed restrictions have on safety and underscores the vulnerability of particular campus areas, particularly those that see a high volume of pedestrian activity.

Further supporting this, Waseem et al. (2019) performed a thorough statistical analysis that examined accident trends before and after the installation of reduced speed restrictions, providing evidence in support of this finding. Their study made use of an extensive dataset that covered several years. According to their findings, slower speeds, especially those under 30 KM/H, give drivers more time to react to unforeseen circumstances, such as pedestrians crossing the street without warning. The study has discovered that this extra reaction time was particularly important for lessening the impact of crashes, which in turn prevented minor events from turning into major accidents with major repercussions.

Moreover, the way campus roads are laid out and designed greatly influences how effective speed limits are. The use of urban design strategies in conjunction with speed limits to produce settings that organically encourage slower driving was examined by Vadeby and Forsman (2018). The properties of well-designed roads, such as small lanes, tight corners, and well-placed speed bumps that automatically reduce vehicle speeds without requiring ongoing enforcement, were the subject of their research. Enhancing safety while integrating smoothly with the appealing and functional architecture of college campuses is the goal of this design-centric approach that strives for a balance between safety and use.

While setting speed limits is crucial, maintaining adherence to them is a constant struggle. In response to this problem, some campuses have put in place traffic calming techniques, which aim to incentivize cars to obey speed restrictions either physically or mentally. A comprehensive case study on the efficacy of different traffic calming techniques, such as speed bumps, chicanes, and improved signage, was carried out by Ojo et al. (2019) According to their findings, these actions considerably lower average vehicle speeds, particularly when paired with visual indicators like narrower lanes and designated pedestrian crossings. It was discovered that these safety measures worked especially well in high-risk areas, like those close to residence halls and university entrances.

Additionally, the control of speed on campuses has also been greatly aided by technological developments. The usage of radar speed signs and other speed detection and feedback technologies, which show a driver's current speed about the posted limit, was investigated by Khan et al. (2020). It has been demonstrated that these gadgets are especially good at changing drivers' behaviours and causing them to reduce their speed right away. These devices have an immediate effect on drivers, but they also have a long-term effect because they gradually teach drivers to maintain slower speeds through continuous exposure to speed feedback. These technologies' psychological consequences were also emphasized, with drivers who can see their speed in real-time being more inclined to abide by speed limits out of worry for their reputation and the desire to avoid negative judgment. Apart from physical and technical interventions, educational initiatives are vital in stressing the significance of obeying speed restrictions on university campuses. Aloi et al., (2020) emphasized the need for awareness-raising initiatives that emphasize the risks of speeding and the advantages of obeying speed limits. Their study proved the worth of educational programs that train teachers and students about the dangers of speeding and provide examples from real-world situations. These initiatives, which are frequently carried out in tandem with campus safety officials and student organizations, support the development of a safety-conscious culture on campus.

Additionally, educational campaigns might be designed to focus on behavioural patterns among various campus groups. For example, assessed the efficacy of the "Learn2Live" program, a peer-led safety initiative aimed at influencing younger drivers, who are frequently more likely to engage in unsafe driving behaviours. The study discovered that encouraging safer driving behaviours in young drivers was most successful when it came from positive peer influence. The researchers effectively used social influence to promote adherence to speed restrictions and develop a sense of community responsibility for upholding a safe campus environment by incorporating well-known campus administrators and student leaders in these programs (Cutello et al., 2020).

Community involvement is another crucial component of successful speed management on campuses. By involving the campus community in conversations regarding speed limits and safety precautions, Aquino et al. (2020) investigated the connection between higher buy-in and compliance. They discovered that there is more compliance and a better sense of ownership over the results when the campus community actively participates in the development and implementation of safety measures.

Additionally, the long-term advantages of community involvement in speed management programs were covered by Outay et al. (2020). They found that in order to keep speed limits effective over time, there needs to be constant community involvement. Drivers may revert to pre-enforcement habits in the absence of ongoing reinforcement and involvement, which would decrease speed limit compliance. Universities can maintain the efficacy of speed limits and improve campus safety by actively incorporating the campus community in policy choices, feedback sessions, and frequent updates.

Research done by Salonen (2018) has provided additional support for the use of technology in speed management by talking about the introduction of autonomous shuttle buses on college campuses. In order to guarantee efficiency and safety, the study emphasized how crucial it is to integrate these autonomous vehicles with the current traffic control systems. The study found that these cars may greatly lower their likelihood of collisions by using sophisticated sensors and strictly enforcing speed limits. According to Shrestha et al. (2021), when campus infrastructures change, speed management techniques must be continuously monitored and adjusted. According to their research, using urban air traffic management systems, especially those that use unmanned aerial vehicles, or UAVs that could provide speed limit enforcement and real-time monitoring, improves campus safety overall.

The long-term viability of speed management systems is just as crucial as the rapid reductions in speed and accident rates. The methods for regulating traffic speeds and upholding security are always changing, much like university campuses themselves. Musselwhite et al. (2020) underlined the necessity of routinely reviewing and modifying speed restrictions and enforcement tactics in response to changes in campus infrastructure, traffic patterns, and population dynamics. Their research made clear how crucial it is to be in constant contact with the community and use technology to monitor and gradually enforce speed limits.

It's critical to take into account how speed limits fit with larger environmental and sustainability goals in addition to making sure they are durable. Musselwhite et al. (2020) have demonstrated that speed restriction legislation can support environmental sustainability by lowering carbon emissions and encouraging alternate modes of transportation. Their research indicates that campuses can accomplish a more complete approach to traffic management by integrating bicycle programs, pedestrian-friendly paths, speed limits, and public transportation. This strategy improves safety while lowering traffic congestion and promoting healthier forms of mobility, which benefits the campus community's general health.

Chapter 3 Methodology

3.1 Introduction

The primary objective for this research project is to examine the speed compliance of vehicles inside of UTAR Kampar campus with a primary focus on straight roads. In this methodology chapter, the whole overview of the research design is provided, including all the reasons and how the research/experiment is going to be executed. Gantt Chart, Diagram Flow, Purchase of Equipment, Type of Data, Measurement Method, Procedure of Data Collection, Data Analysis Method and Limitations are the elements that are contained in this chapter. This chapter’s primary objective is to perform an extensive assessment of the speed compliance of UTAR staff and students in UTAR Kampar campus. A structured approach to identify the zones that vehicles are not complying with speed limit that were set by UTAR Department of Security of Kampar campus is used. The speed limit inside UTAR Kampar campus is 30km/h for the surrounding roads and 15km/h for parking zones.

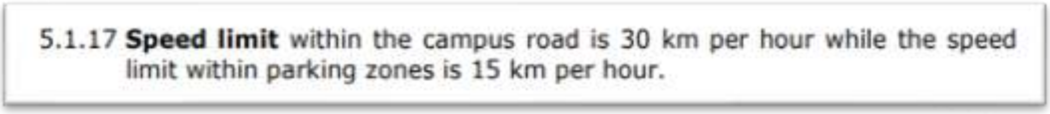

5.1.17 **Speed limit** within the campus road is 30 km per hour while the speed limit within parking zones is 15 km per hour.

Figure 3.1.1 Speed stated inside UTAR Parking and Traffic Regulation

This study is aimed to accurately record and analyse the average speed of vehicles that passed through the checkpoint zones that have been set up in 4 different time zones in a day. Furthermore, the ethical considerations related to data collection and confidentiality will be discussed. The methodology aims to establish a clear framework that makes the research process easier to understand and allowing readers to evaluate the reliability of the findings. The results of this study could also be useful for future research and contribute to ongoing discussions on traffic management in educational settings.

3.2 Gantt Chart

The below figures present the Gantt Chart.

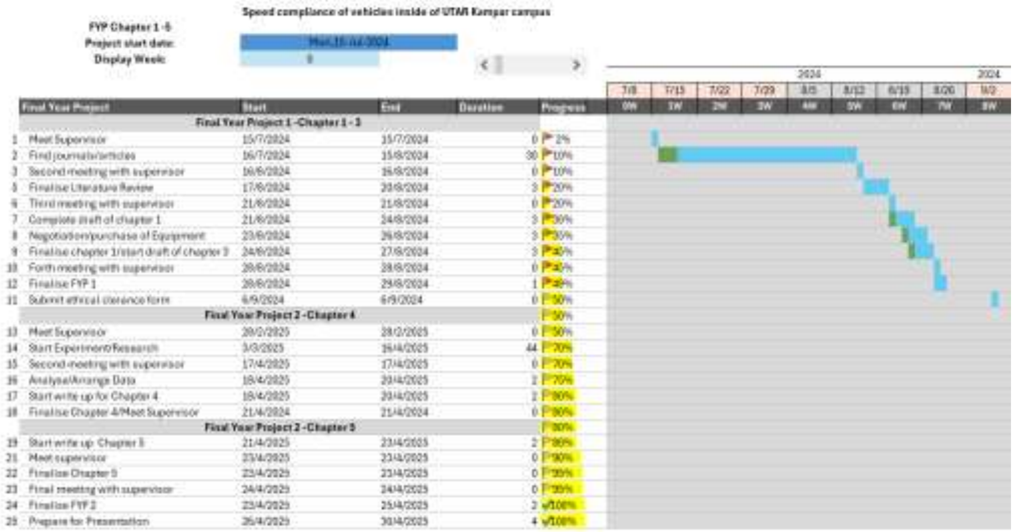


Figure 3.2.1 Gantt Chart

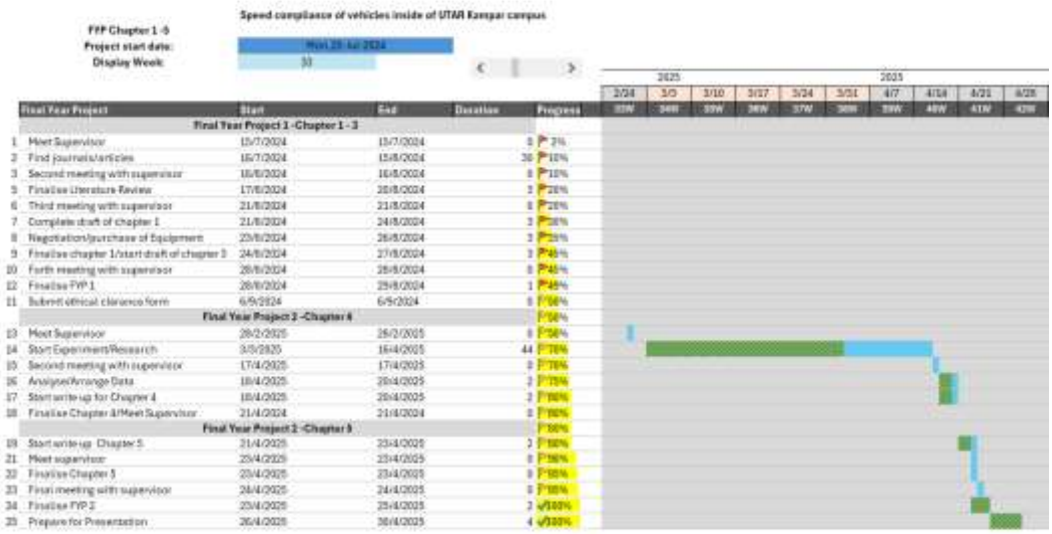


Figure 3.2.2 Gantt Chart

3.3 Diagram Flow

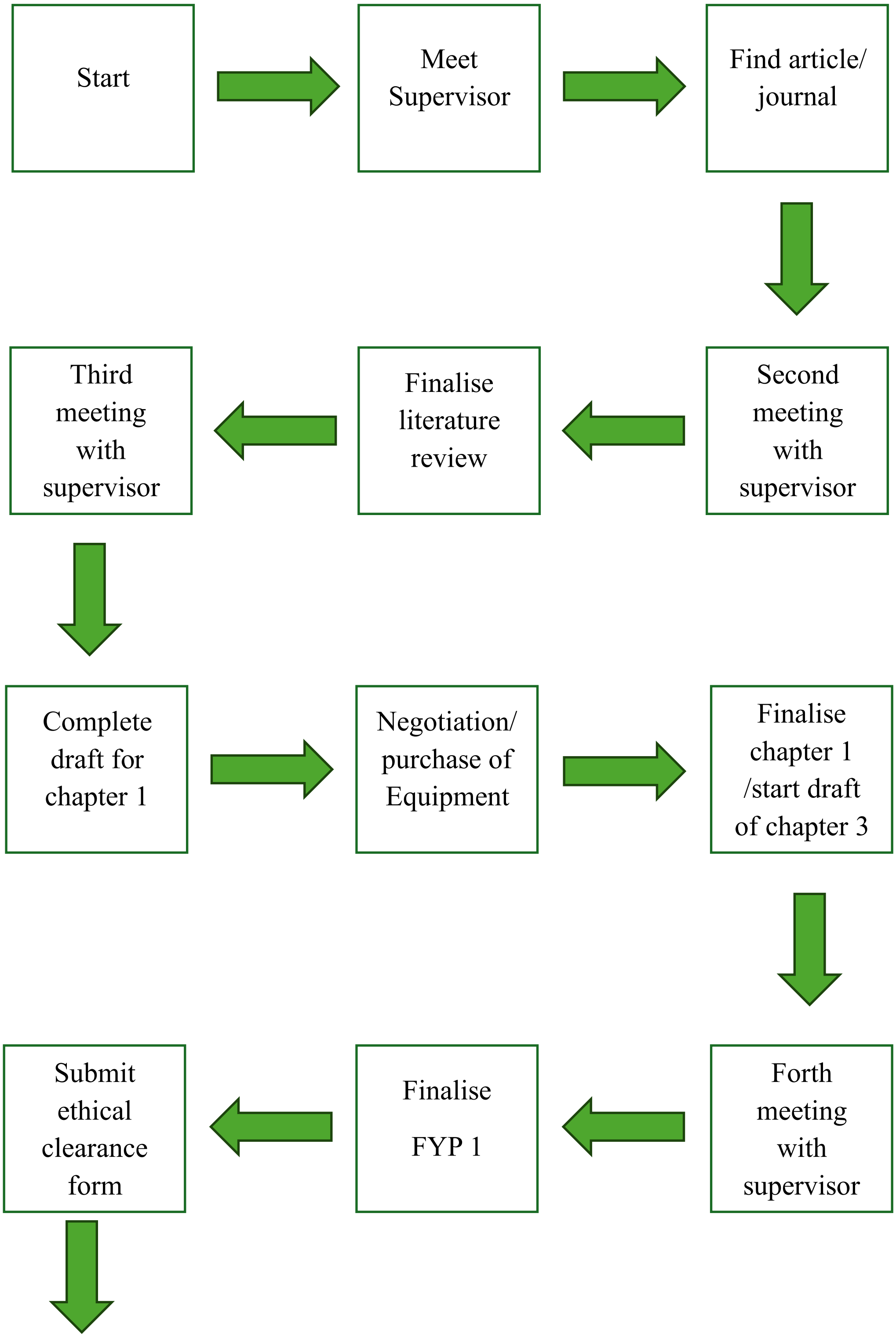


Figure 3.3.1 Diagram Flow

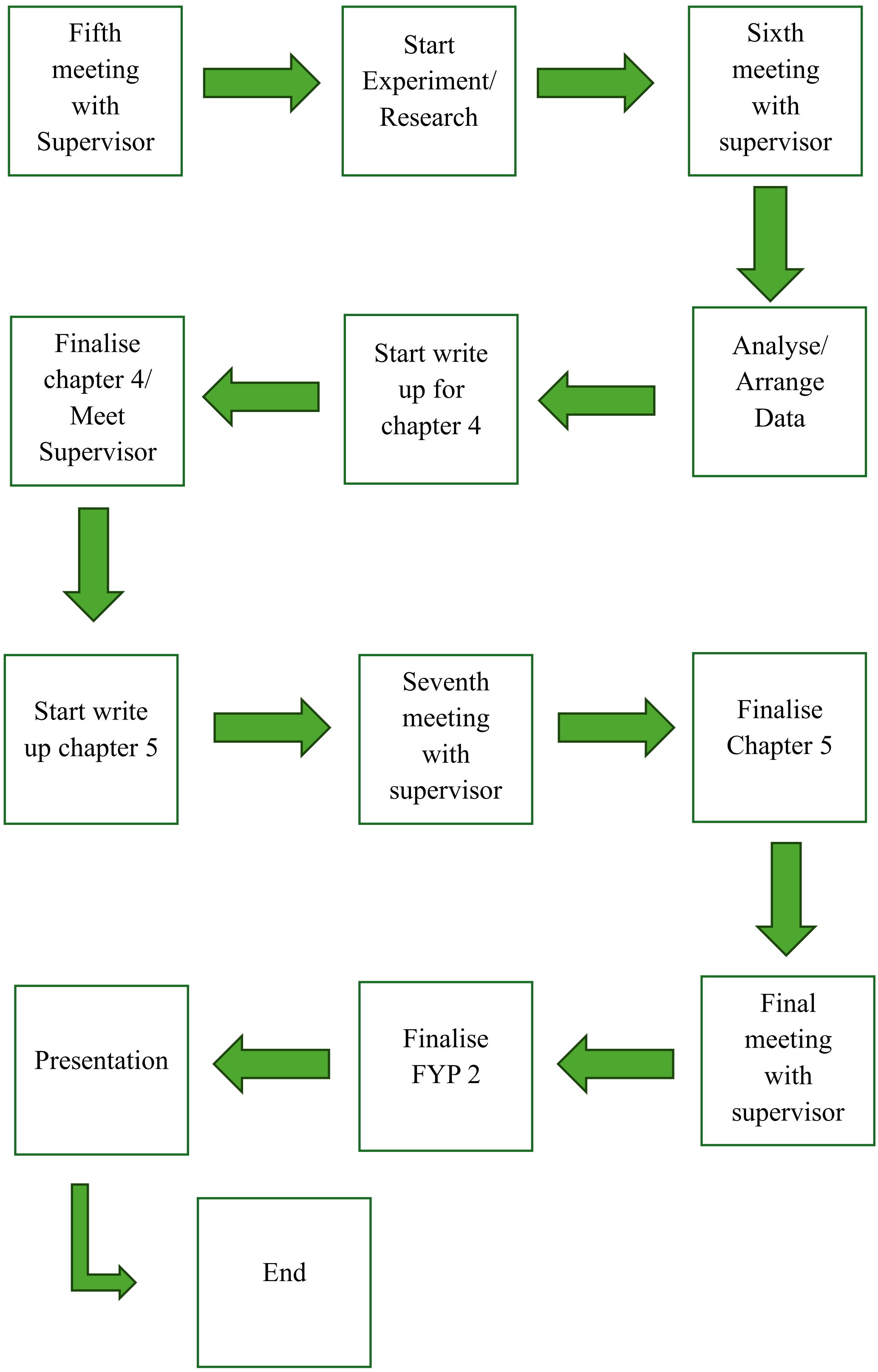


Figure 3.3.2 Diagram Flow

3.4 Purchase of Equipment

As accurate speed data is needed to calculate the data of average speed of cars inside of the campus, the usage of velocity speed gun is needed. This is ensured to get accurate reading of the vehicles speed and it will not be complicated as minimal calculations are required. The search for the speed gun was started by exploring various online selling platforms. Different brands, different models from different countries were taken into consideration. The most common velocity speed gun in the market was from a brand called Bushnell. But the price of the basic model of the Bushnell brand which is Bushnell Radar Speed Gun was around RM1,547.

The alternative was from a brand called Stalker. The Stalker Basic velocity gun also serves similar purpose as other velocity guns, but the price of the item is different. With the help of previous UTAR Students, a second-hand Stalker Basic Speed Gun was purchased with a price tag of RM250. This was a good bargain considering that the price of the new item will be double or triple of the amount that was paid. In online platforms, the price of the same product will be around few hundred US Dollars.

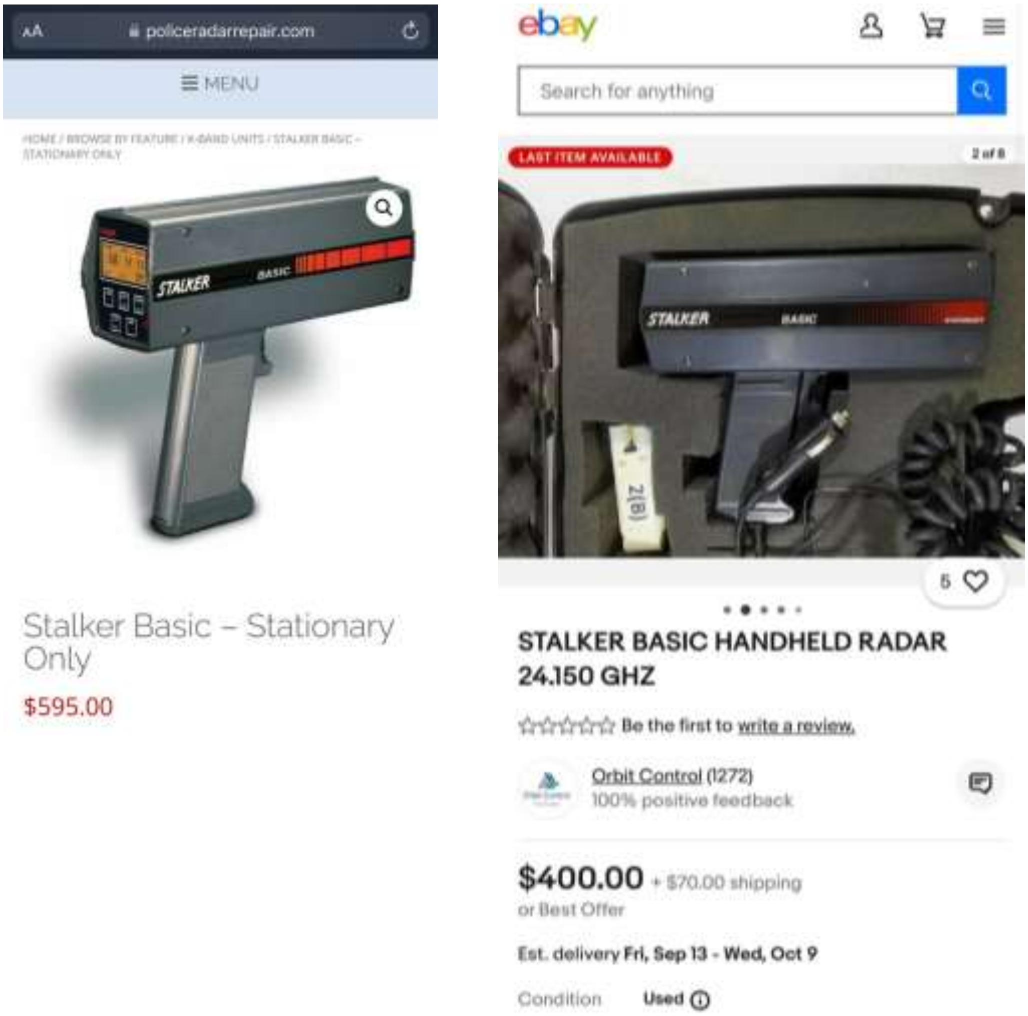


Figure 3.4.1: Price of Stalker Basic in online platforms

3.4.1 Specifications

The item that was purchased is called Stalker Basic Handheld Radar 24.150 GHZ. As per the name itself, the gun operates at a frequency of 24.150 GHZ. The specification of the item includes trigger actuated transmitter, adjustable sensitivity and doppler audio. Apart from that, the gun also comes with LCD display and also a blacklight key.

3.4.2 Function/Way of Operating

The method of operation used to operate the speed gun is by using the standstill method. This means that the speed gun will be held on a stationary position so that there will be minimal movement. When using the stationary method, the speed gun will not be moving, and it will be detecting the cars that are approaching it. (Lindquist, 2022). The author also mentioned that putting the radar gun closest to the route that is being experimented will help to increase the accuracy of data. The best angle to capture the speed of a vehicle will be 0 degrees. However, since that is suitable for the research because of safety concerns as per illustrated in figure 3.4.2 and 3.4.3, the speed gun will be placed at an angle of 45 degrees while facing the same direction as the traffic. When a target vehicle is approached, the speed gun should be triggered and when the target vehicle is at a parallel level with the "capturing zone" the trigger should be released.

Figure 3.4.2: 0-degree angle

Figure 3.4.3: 0-degree angle

The pictures above were taken at nighttime in order to ensure the safety.

3.5 Type of Data

3.5.1 Primary Data

Primary data are sources that evaluate different components and characteristics that help determine the goals and fields of study for the research project. Primary data is functional for helping with specific issues by offering expertise and sufficient information for a high level of advancement in the researchers' endeavour seeking to achieve consequent. Real-time data such as experiments and observations are essential components of primary data that support the investigation of the study. In this study, the most significant primary data will be the speed of the vehicles inside UTAR. Apart from the speed of vehicles, location and time also can be considered as the primary data for this research. According to Table 3.6.1, there are 16 checkpoints and according to Table 3.7.1, there are 4 times zones of when the research will be conducted. In this instance, a radar speed gun provides a reliable and efficient data device for real-time monitoring of the differences between the study and reality. Straight roads, curved roads, and parking zones are examples of external factors that will be taken into consideration while measuring for the research. For the research, applying practical facts over theoretical sources will take precedence.

3.5.2 Secondary Data

Secondary data are those that are produced or examined for reference value by other researchers. The public and scholars may access to records and data from databases, case studies, and literature reviews due to secondary data. The advantage is that the researcher may examine points of view by just requesting inquiry access to the database, preventing them from having to carry out a fresh origin study. Aside from that, secondary data completes several tasks, including risk reduction, discussion and discoveries, and project feasibility effectively. For example, the research makes use of secondary data from an examination of the speed compliance of cars on campus and driver behaviour regarding speed and the sufficiency of traffic indications. For the study, the researchers also used measurements of the diversity of roadways within the campus that were made by other researchers.

3.6 Measurement Method

To get the data of vehicles speed, there are 2 observations to measure about the speed which are manually and mechanically. Then, these observations will be compared to find out the most suitable method to use in this research.

Table 3.6.1: Research routes

In Direction	Out Direction
CP1. Westgate to Block P	CP9. Block P to Westgate
CP2. Westgate to Block A	CP10. Block A to Westgate
CP3. Block A to Block B (Curvy Road)	CP11. Block B to Block A (Curvy Road)
CP4. Eastgate to Block H	CP12. Block H to Eastgate
CP5. Block H parking (with humps) (Entering)	CP13. Block H parking (with humps) (Exiting)
CP 6. Block A parking (without humps) (Entering)	CP14. Block A parking (without humps) (Exiting)
CP 7. Block L (Narrow Road) (Inner Ring)	CP15. Block L (Narrow Road) (Outer Ring)
CP 8. Block L to Block M	CP16. Block M to Block L

Table 3.6.2: Colour of research routes in UTAR by using Google Maps

CP1 & CP9	CP2 & CP10	CP3 & CP11	CP4 & CP12	CP5 & CP13	CP6 & CP14	CP7 & CP15	CP8 & CP16

Figure 3.6.1: Highlighted research routes in UTAR by using Google Maps

About manually observation, there is not any professional equipment to be used in this research, only the timer and distance measuring wheel will be used in this method. At first, the distance between the two points stated in Table 3.1 will be measured by distance measuring wheel. Then, the time of a vehicle to pass through this distance will be recorded for the calculation of average speed. The average speed will be calculated by using the formula, $Speed = {Distance}/{Time}$. Lastly, the speeds calculated will be used to determine compliance.

In the other hand, a Radar speed gun (Stalker Basic radar gun) will be used to spot the speed of vehicles that pass by the research routes. Then, the speed value can be detected by pressing the trigger and will show on the display screen of the speed gun. A checkpoint will be set at the location which they may start braking for other behaviours such as pass the bump and have a left or right turn. This enables to spot the fastest speed which the vehicles act and allows to determine whether fulfil the speed compliance.

In a nutshell, the manual observation only allows to determine the average speed, the highest speed can't be found out. However, if the checkpoints are accurate in the fastest speed area, then it can be used to determine whether exceeding the speed limit due to the tiny range. Furthermore, this observation requires a long time and energy to calculate the speed data. In the other hand, mechanical observation can be more accurate, efficiency and effective to spot the speed value of passed vehicles. As speed gun can reduce the risk of human error in calculation, then it is simple to use and provide the result in few seconds.

3.7 Procedure of Data Collection

There are few routes that enable vehicles to drive faster than the speed limit, which is listed in table 3.1, therefore this research will mainly focus on these routes to collect the speed data of vehicles that might exceed the speed limit. There are 16 checkpoints (listed in table 3.1) that will be monitored into four time zones which are 7.30am - 9.00am, 11.30am - 12.30pm, 2.30pm - 3.30pm and 5.00pm - 6.30pm totally for 5 hours of detection.

After that, these routes are be picked based on their straight, curved and also narrow components. So, drivers can have a fast drive on these routes due to some of them are absence of the slow down measures such as bumps. This can examine the drivers' self-control and self-discipline ability. Furthermore, the checkpoints are selected randomly to determine whether drivers have complied with the regulations no matter where and when.

Table 3.7.1: Timetable for speed data collection.

Time / Day	7.30am – 9.00am (T1)	11.30pm – 12.30pm (T2)	2.30pm – 3.30pm (T3)	5.00pm – 6.30pm (T4)
D1	CP1 SB & YY		CP12 ZL & HW	
D2		CP8 YY & ZL		CP6 SB & HW
D3		CP5 SB & ZL	CP2 YY & HW	

D4	CP8 YY & ZL			CP10 SB & HW
D5			CP8 SB & HW	CP12 YY & ZL
D6	CP4 ZL & HW	CP15 SB & YY		
D7		CP11 SB & HW		CP5 YY & ZL
D8	CP6 SB & ZL		CP4 YY & HW	
D9	CP11 SB & YY	CP3 ZL & HW		
D10			CP11 YY & HW	CP1 SB & ZL
D11	CP2 YY & ZL			CP14 SB & HW
D12		CP13 YY & HW	CP5 SB & ZL	
D13		CP4 SB & HW		CP15 YY & ZL
D14	CP9 YY & HW		CP3 SB & ZL	
D15	CP14 ZL & HW			CP13 SB & YY

D16		CP16 SB & YY	CP6 ZL & HW	
D17	CP5 YY & ZL		CP10 SB & HW	
D18		CP1 YY & HW		CP8 SB & ZL
D19		CP9 YY & ZL	CP14 SB & HW	
D20	CP16 YY & HW			CP11 SB & ZL
D21			CP7 SB & YY	CP2 ZL & HW
D22	CP13 ZL & HW	CP12 SB & YY		
D23		CP14 SB & ZL		CP16 YY & HW
D24	CP15 ZL & HW		CP16 SB & YY	
D25	CP10 SB & HW	CP2 YY & ZL		
D26			CP15 YY & HW	CP4 SB & ZL
D27	CP3 SB & YY			CP9 ZL & HW

D28		CP7 SB & HW	CP13 YY & ZL	
D29		CP10 SB & ZL		CP7 YY & HW
D30	CP12 SB & ZL		CP9 YY & HW	
D31	CP7 SB & YY			CP3 ZL & HW
D32		CP6 SB & HW	CP1 YY & ZL	

SB: Salamon Brangiss YY: Sin Yi Yang

ZL: Sim Zheng Lin HW: Chee He Wid

To allocate the task for each member more fairly, members are divided into 2 groups to conduct the detecting and recording tasks according to Table 3.1. Apart from that, due to the Radar speed gun is required to charge for 5 hours and operate for 2.5 hours maximum, so there are only 2 times per day. Then, they are required to record 64 groups of data responsibly as 32 groups for each group for 32 weeks. The allocation of responsibility for which routes and which time also had been mentioned in the table. So, it provided a clear task for their responsibilities.

As per 3.4.2, the speed gun will be placed at an angle of 45 degrees while facing the same direction as the traffic. Apart from the speed gun an excel sheet to record data, a tripod and an object will be needed to carry out this research. The speed gun should be placed on the tripod and the tripod should be set to its maximum height. The speed gun and the tripod will be placed the closest possible to the road without causing harm to the researchers and the oncoming vehicle. The mark will be set to determine the “capturing zone”. A painted stick will be used as the mark. As per 3.4.2, When a target vehicle is approached, the speed gun should be triggered and when the target vehicle is at parallel level with the “capturing zone” the trigger should be released. This data should be recorded in the excel sheet for further analysis and calculations. To avoid lacking time to record due to many vehicles and logging errors, a phone will be installed on the tripod to record the speed value of Radar speed gun for a backup reference for these incidents.

Figure 3.7.1: Set up for capturing vehicles speed data when pass by checkpoint

Figure 3.7.2: Backup recording

3.8 Data Analysis

In this study, the data analytical method involves quantitative data analysis mainly focusing on vehicle speed collection on straight roads at different zones in UTAR Kampar campus. This analysis is important for understanding traffic behaviour of UTAR staffs and students, and for enhancing road safety in the campus. There is a total of 16 research routes for this study (refer to Table 3.6.1), and the data will be collected by using a radar speed gun to get the data of the vehicles after they pass through the radar speed gun (refer to figure 3.7.1). This method allows to get the vehicle speed on the 16 research routes. By conducting data analysis, precise insight into the speed patterns of driving behaviour of drivers within the UTAR Kampar campus can be obtained.

Moreover, the collected speed data will be evaluated by using measures like mean speed, mode speed, median speed, standard deviation, and the highest speed of vehicles. Mean speed was calculated to determine a vehicle's average speed of all the vehicles in the different research routes that have been set. Mode speed was captured to identify the most common speeds of vehicles pass through the different research routes. Median speed was recorded to determine the centre speed value of all the vehicles that pass through the research routes. Standard deviation is calculated to measure the spread of data relative to the mean while the higher the standard deviation is calculated to indicate the data that is tightly around the mean, which is less reliable. The highest speed is recorded as well to know the top vehicle speed that passes through the research routes.

Formula:

Mean speed (km/h) = $\frac{Sum\ of\ Speeds\ of\ Vehicles\ on\ Straight\ Road}{Total\ Number\ of\ Vehicle\ Speed}$

Mode Speed (km/h) = The most frequent speed captured

Median Speed (km/h) = $[\frac{(Total\ Number\ of\ Vehicle\ Speed+1)}{2}]^{th}$

Standard Deviation (km/h) =

$$\sqrt{\frac{Sum\ of\ (\ Difference\ Between\ each\ Vehicle\ Speed\ and\ Mean)^{2}}{Total\ Number\ of\ Vehicle\ Speed-1}}$$

Highest Speed (km/h) = The highest speed on the research routes

Moreover, this study helps to determine the difference in the mean speed of the different research routes after various vehicles drove through the routes by using an independent t-test. Independent t-test refers to inferential statistics that used to determine if there is a significant difference between the vehicle speed driving through the routes and how related they are as there will be various speed patterns. The t-test will be conducted by using Microsoft Excel.

The statistical analysis of this speed data will then be linked to the speed compliance of drivers in UTAR Kampar campus. This approach can help to figure out the factors that are most effective in encouraging drivers to stick to the speed limit in the campus. It also looks at how different aspects, like the design of the roads, the amount of traffic, and various environmental conditions, affect how drivers behave and whether they comply with UTAR speed limit. The analysis also considers how these factors influence the likelihood of speeding, the level of compliance, and the overall safety of traffic in the area.

By conducting the analysis, a thorough assessment of vehicle speed compliance across 16 different road segments in UTAR Kampar campus was able to be conducted. Independent t-test are used to help us determine whether there are significant differences in speed patterns across the various research routes and different time periods. Statistical metrics are utilized to identify the most effective way or strategy to find improving compliance with the campus speed limit of 30km/h. This approach does not only enhance the future traffic management and safety but also supporting the enforcement of UTAR traffic regulations, ensuring that drivers adhere to the speed limit on UTAR Kampar campus.

3.9 Limitations

3.9.1 Accuracy Concern

One of the variables in the investigation will be accuracy during the experiment, which is the radar speed gun's reliability. A variety of factors can impact the actual performance, increasing the possibility of data error. The speed readings may also be accurate if there are some obstacles encountered during reading. The radar speed gun will undoubtedly provide a variety of observations from the measurement based on the height and angle, which require complex data analysis. In that instance, different statistical findings may occur that are insufficiently stable and non-reliable for the purpose of inquiry. This is because clocking the angle error will lead to an inaccurate or slower speed compared to the actual speed. According to Table 3.9.1, the higher the degree, the higher the possibility of error will be displayed. To guarantee that the distance is within the acceptable range, managing the angle is crucial. Aside from that, hand stability is essential to get precise information with no data reading errors because the speed gun is a handy instrument. The vehicle's speed will have an impact on the readout because of its rapid acceleration which can cause the speed gun malfunction. Aside from that, a large number of vehicles passing might lead to problems like the radar speed gun failing. This is due to the speed gun's inability to scan an excessive number of cars at once, which would provide inaccurate and incorrect data for the experiment.

Table 3.9.1: Cosine Error Angle Chart

	0 Degrees	5 Degrees	10 Degrees	15 Degrees	30 Degrees	45 Degrees	90 Degrees
True Speed	0% Error	0.4% Error	1.5% Error	3.4% Error	13.4% Error	29.3% Error	100% Error
25.0 mph	25.0 mph	24.9 mph	24.6 mph	24.1 mph	21.7 mph	17.7 mph	0 mph
50.0 mph	50.0 mph	49.8 mph	49.2 mph	48.3 mph	43.3 mph	35.4 mph	0 mph
75.0 mph	75.0 mph	74.7 mph	73.9 mph	72.4 mph	65.0 mph	53.0 mph	0 mph
100.0 mph	100.0 mph	99.6 mph	98.5 mph	96.6 mph	86.6 mph	70.7 mph	0 mph
125.0 mph	125.0 mph	124.5 mph	123.1 mph	120.7 mph	108.3 mph	88.4 mph	0 mph
150.0 mph	150.0 mph	149.4 mph	147.7 mph	144.9 mph	129.9 mph	106.1 mph	0 mph
200.0 mph	200.0 mph	199.2 mph	197.0 mph	193.2 mph	173.2 mph	141.4 mph	0 mph
250.0 mph	250.0 mph	249.0 mph	246.2 mph	241.4 mph	216.5 mph	176.8 mph	0 mph

3.9.2 Lack of Manpower

It is challenging to observe due to the massive campus setting when there isn't enough manpower. It can be tough to work concurrently for the highly progressed research with only 4 individuals. The experiment's region concludes eight checkpoints where labour-intensive and distant requirements are needed. To avoid personnel shortages in this situation, people must get together to review the observation for greater maximization division of manpower. As a result, it will require a longer time for the demonstration research. Other than region, there were four other time zones as well such as morning, afternoon, evening, and night. To divide the task efficiently, two groups with two people each will be assigned equally to perform in the observation throughout the campus. The usage to optimize the work will result in increased efficiency without any delay or error, even if it will take some time.

3.9.3 Weather Conditions

Public experiments can be greatly impacted by weather, particularly when they are carried out outside or in climate-sensitive areas. One element that can affect how studies turn out is temperature. For example, high temperatures might hinder outdoor research because of the intense heat that can result in severe physical problems like heatstroke. Apart from that, precipitation can also disrupt outdoor studies by causing equipment damage and changing climatic variables that are essential to the experiment. The phenomena of precipitation might also cause the driver to deviate from their typical driving style, which is more cautious and alert out of safety concerns. This might provide unstable and inconsistent investigational data that isn't sufficiently precise to back up the study's statement. In this case, constant outdoors research practice is necessary to guarantee the reliability and accuracy of the experiment's findings under controlled or accounted-for weather conditions.

3.9.4 Safety Concerns

Due to the necessity for a fresh spot to measure the objective according to the requirements of the study. When determining the best data to support the study, there are eight checkpoints to take into consideration. These checkpoints are located on narrow, corner, and curving roadways that have a high incident risk. This is due to the possibility that the driver's sight or judgment to maintain speed may be affected by the fast turns and corners, potentially resulting in loss of control. Additionally, the lateral force may make it difficult to turn at a certain angle, which might result in a sideswipe occurrence. Furthermore, narrow roads provide less space for cars to drive, which raises safety issues for the experiment at the fixed checkpoint because vehicles like buses and lorries require more area to handle turns. In this situation, individuals participating in the experiment will have to carefully consider potential risks to their own safety. The best method to prevent accidents is to maintain as much of a distance as can be maintained during the experiment.

3.9.5 Time-Consuming

Competing against time can be challenging for the duration of the experiment. This happens because gathering and analysing data outdoors will in reality take longer due to a number of reasons, including the cost of tools and equipment. To assess precise digital data, angle, and stance to support the study's factual performance, tools and equipment like a radar speed gun and tripod are required. However, it is unavoidable that time will need to be spent learning how to operate and utilize the equipment step-by-step. For example, the radar speed gun required exact timing to learn when to press and release the button to detect the target vehicle. Regarding the speed gun, its battery needs a lot of time to charge, and it isn't sufficient enough for an effective experiment optimally. For example, the speed gun required a whole day of charging only for a couple hours of usage. As a result, it is problematic to do the experiment so frequently considering the battery's capacity limitations.

Chapter 4 Results/ Findings

4.1 Descriptive Analysis

Table 4.1.1: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Total Checkpoints, Main Road Checkpoints and Parking Zone Checkpoints

Checkpoints (CP)	Critical statistical Measures				
	Mean	Mode	Median	Standard Deviation	Percentage of Compliance (%)
Total	34.1716	29	35	9.9584	26.93%
Main Road	36.5854	29	37	8.1614	26.72%
Parking Zone	18.1654	18	18	4.5204	28.28%

From the data collection, the speed of vehicles is revealed on the main road in campus. The mean speed is the average speed of all vehicles passing through the main road. With a posted limit of 30 km/h, the recorded **mean speed of 36.59 km/h** indicates that, on average, vehicles are traveling significantly above the permissible threshold. The mean speed on the main road of CP7 was the lowest (26.78 km/h), while CP1 was the highest (50.39 km/h). This indicates that CP7 vehicles travel at an average speed of 26 km/h, and CP1 vehicles travel at an average speed of 50 km/h. The difference in mean speed is due to differences in the width and narrowness of the road. Interestingly, the **mode is 29 km/h**, suggesting that the most commonly observed speed does fall within the acceptable range. However, this is overshadowed by the fact that the majority of speeds are higher, as evidenced by the elevated mean and median. Besides that, the median speed is the middle of all 6777 vehicle speeds on the main road. The **median speed is 37 km/h**, showing that at least half of the drivers are exceeding the speed limit, which is alarming in a pedestrian-rich environment like a university campus. Next, standard deviation measures the dispersion or distribution of speeds around the mean. The lower the standard deviation, the less the speed data is spread out from the mean. In the data, CP1 has a wider speed range of 10.62 km/h, while CP7 has the lowest speed range of 2.53 km/h. The highest speed recorded represents the highest speed at which the vehicle passed the main road. In the data, most of the speed limit has a higher speed on the main road, except the CP4 (27.56 km/h), CP15 (28.29 km/h), CP15 (29.01 km/h), CP7 (28.82 km/h) and CP7 (28.57 km/h) which under the campus speed limit, 30 km/h.

On the other hand, the mean speed is the average speed of all vehicles passing through the parking area. With a posted limit of 15 km/h, the recorded **mean speed of 18.17 km/h**, which exceeds the speed limit. The mean speed on the main road of CP14 was the lowest (14.85 km/h), while CP5 was the highest (22.45 km/h). This indicates that CP14 vehicles travel at an average speed of 14 km/h, and CP5 vehicles travel at an average speed of 22 km/h. The difference in mean speed is due to differences in the repetition of drivers who keep searching for parking at various speeds. Next, the **mode is 18 km/h,** which reveals the drivers are consistently speeding. The **median speed** of all 1022 cars in the parking area is **18km/h**, showing that the majority of drivers didn't comply with the speed limit. Next, standard deviation measures the dispersion or distribution of speeds around the mean. The lower the standard deviation, the less the speed data is spread out from the mean. In the data, CP5 has a wider speed range of 6.62 km/h, while CP14 has the lowest speed range of 1.9 km/h. The highest speed recorded represents the highest speed at which the vehicle passed the parking areas. In the data, most of the vehicles have a higher speed in the parking areas, except the CP14 (14.85 km/h) and CP14 (14.98 km/h), which are under the campus speed limit, 15 km/h.

Table 4.1.2: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Total Checkpoints based on Time Zone

Time Zone	Critical statistical Measures				
	Mean	Mode	Median	Standard Deviation	Percentage of Compliance (%)
7.30am – 8.30am	33.9304	29	34	9.2976	29.16%
11.30am – 12.30pm	34.3443	38	36	10.6674	22.05%
2.30pm – 3.30pm	34.8337	38	36	9.7627	22.09%
5.30pm –	33.7001	29	33	9.9808	33.68%

6.30pm					

According to data collection table 4.1.2, speed compliance is greater in the peak hours of section 7.30 am–8.30 am and section 5.30 pm–6.30 pm, at 29.16% (603 cars) and 33.68% (674 cars), respectively. This is due to the large number of vehicles, which are 2068 and 2001 cars respectively entering the checkpoint with high centralization, which effectively reduces drivers' speeding behaviour. However, the speed compliance rate during non-peak hours between 11.30 am and 12.30 pm, 2.30 pm and 3.30 pm registered at 22.05% (463 cars) and 22.09% (360 cars) respectively. The inspections of 2100 and 1630 vehicles occur through deconcentrated methods. From table 4.1.2, the means indicate vehicles are traveling significantly above the permissible threshold, which each section revealed 33.93 km/h, 34.34 km/h, 34.83 km/h, and 33.70 km/h respectively. Next, the median speed is 34 km/h, 36 km/h, 36 km/h and 33 km/h respectively, showing that at least half of the drivers exceed the speed limit of 30 km/h, which is alarming in a pedestrian-rich environment like a university campus. Moreover, the mode of section 7.30 am-8.30 am and section 5.30 pm-6.30 pm is 29 km/h, suggesting that the most commonly observed speed does fall within the acceptable range. Interestingly, the mode of section 11.30 am-12.30 pm and section 2.30 pm-3.30 pm is 38 km/h, suggesting that the most commonly observed speed does not fall within the acceptable range. Other than that, section 11.30 am-12.30 pm regarding the standard deviation has a wider speed range of 10.67 km/h, which indicates that the higher the speed, the more data is spread out from the mean. In contrast, section 7.30 am-8.30 am represents a lower speed range of 9.30 km/h; the lower the standard deviation, the less the speed data is spread out from the mean.

Table 4.1.3: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Main Roads Checkpoints based on Time Zone

Time Zone	Critical statistical Measures				
	Mean	Mode	Median	Standard Deviation	Percentage of Compliance (%)
7.30am – 8.30am	35.7465	29	35	8.0595	30.56%
11.30am – 12.30pm	37.8428	38	38	7.8750	19.00%
2.30pm – 3.30pm	37.0325	38	37	7.9648	21.47%
5.30pm – 6.30pm	35.8529	29	35	8.5222	34.66%

According to data collection table 4.1.3, speed compliance is greater during peak hours of section 7.30 am–8.30 am and section 5.30 pm–6.30 pm, at 30.56% (563 cars) and 34.66% (608 cars), respectively. This is due to a high degree of centralization, which effectively reduces the number of speeding drivers, since there are many cars entering the checkpoint (1842 and 1754 cars, respectively). However, the speed compliance rate was 19% (330 cars) and 21.47%

(310 cars) during off-peak hours, which are between 11.30 am and 12.30 pm and 2.30 pm and 3.30 pm, respectively. Deconcentrated methods are used to check vehicles 1737 and 1444. The averages in Table 4.1.3 show that cars are exceeding the allowed speed by a large amount; the corresponding speeds for each stretch were 35.75 km/h, 37.84 km/h, 37.03 km/h, and 35.85 km/h. The median speed is then 35 km/h, 38 km/h, 37 km/h, and 35 km/h, respectively, indicating that at least half of the cars go faster than the 30 km/h speed restriction, which is concerning in an area with plenty of foot traffic, such as a university campus. Furthermore, 29 km/h is the norm for sections 7.30 am–8.30 am and 5.30 pm–6.30 pm, indicating that the most often recorded speed does indeed fall inside the permissible limit. It's interesting to note that the most often recorded speed does not fall inside the allowed limit, since the mode for sections 11.30 am–12.30 pm and 2.30 pm–3.30 pm is 38 km/h. In addition, the speed range in section 5.30 pm–6.30 pm for the standard deviation is broader at 8.52 km/h, suggesting that the greater the speed, the more data deviates from the mean. A smaller speed range of 7.88 km/h is represented by section 11.30 am–12.30 pm; the lower the standard deviation, the less dispersed the speed data is from the mean.

Table 4.1.4: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Parking Zone Checkpoints based on Time Zone

Time Zone	Critical statistical Measures				
	Mean	Mode	Median	Standard	Percentage of

				Deviation	Compliance (%)
7.30am – 8.30am	19.1283	19	19	3.9482	17.70%
11.30am – 12.30pm	17.6033	15	17	4.7585	36.64%
2.30pm – 3.30pm	17.7634	19	18	3.8398	26.88%
5.30pm – 6.30pm	18.4130	18	18	4.9640	26.72%

According to the data collection table 4.1.4, speed compliance in the parking area is different than the main road. The higher percentage of speed compliance in the parking area is from section 11.30 am-12.30 pm and section 2.30 pm-3.30 pm, which are 36.64% (133 cars) and 26.88% (50 cars). This is due to the fact that students keep finding parking lots due to the massive volume of lots that are completely parked, which means students need time to search for parking at a sustainable low speed. Thus, there is a lower speed compliance in the parking area during section 7.30 am-8.30 am and section 5.30 pm-6.30 pm, which are 17.70% (40 cars) and 26.72% (66 cars). This is because students will usually enter the parking area at a higher speed due to the empty slots available in early classes, and students will leave rapidly after the final classes as well. From Table 4.1.4, based on the 15 km/h speed limit in parking area, the means indicate vehicles are traveling significantly above the permissible threshold, with each section revealing 19.13 km/h, 17.60 km/h, 17.76 km/h, and 18.41 km/h respectively. Next, the median speed is 19 km/h, 17 km/h, 18 km/h and 18 km/h respectively, showing that at least half of the drivers exceed the speed limit of 15 km/h, which is alarming in a pedestrian-rich environment like a university campus. Moreover, the mode of section 11.30 am-12.30 am is 15 km/h, suggesting that the most commonly observed speed does fall within the acceptable range. Interestingly, the mode of section 7.30 am-8.30 pm, section 2.30 pm-3.30 pm, and section 5.30 pm-6.30 pm is 19 km/h, 19 km/h and 18 km/h respectively, suggesting that the most commonly observed speed does not fall within the acceptable range. Other than that, section 5.30 pm-6.30 pm regarding the standard deviation has a wider speed range of 4.96 km/h, which indicates that the higher the speed, the more data is spread out from the mean. In contrast, section 2.30 pm-3.30 pm represents a lower speed range of 3.84 km/h; the lower the standard deviation, the less the speed data is spread out from the mean.

Table 4.1.5: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Each Checkpoints on section 7.30am-8.30am

Checkpoints (CP)	Critical statistical Measures				
	Mean	Mode	Median	Standard Deviation	Percentage of Compliance (%)
1	39.2818	42	40	8.3693	13.56%
2	33.5167	33	34	7.3265	28.33%

3	30.941	29	30	4.7159	58.69%
4	27.5629	28	28	4.6182	75.50%
5	20.463	19	20	3.2394	5.56%
6	18.3053	20	18	4.2678	26.32%
7	30.1364	29	29	3.8105	66.67%
8	38.4063	40	39	6.777	14.58%
9	30.5	32	30.5	3.7491	50.00%
10	35.6863	39	37	6.4544	23.53%
11	44.3718	42	44	6.4998	1.92%
12	39.4921	39	39	4.4355	1.59%
13	18.1	17	17.5	2.7264	10.00%
14	14.8462	13	15	2.8823	61.54%
15	35.0238	32	35	7.7578	31.75%
16	35.3563	35	35	5.0424	18.75%

According to Table 4.1.5 of section 7.30am-8.30am, CP1, CP11 and CP12 represent the highest mean speed by 39.28 km/h, 44.37 km/h and 39.49 km/h. If the speed limit is 30 km/h and the mean speed at a checkpoint is higher than that, it indicates that, on average, vehicles are exceeding the legal speed limit. This reflects a general trend of non-compliance with traffic regulations in the area. Next, higher mode speed like CP1 (42 km/h) and CP11 (42 km/h) indicate the most frequently occurring speed among vehicles is above the legal limit. This indicates that not only are many drivers exceeding the speed limit, but speeding has become the common behaviour at that checkpoint. Moreover, CP1 (40 km/h) and CP11 (44 km/h) which own higher median than 30 km/h indicates that more than half of the vehicles are driving above the legal limit. Unlike the mean, which can be influenced by a few extreme values, the median provides a clearer picture of the typical driver's behaviour. Next, standard deviation measures the dispersion or distribution of speeds around the mean. CP1 (8.37 km/h) contained the wider speed range since the standard deviation is high, it suggests not only are many drivers speeding, but there's also a mix of behaviours—some drivers might be significantly exceeding the limit while others are closer to it or even below. Low standard deviation like CP13 (2.73 km/h) indicate that most drivers are consistently speeding, which points to a widespread and uniform disregard for the speed limit. Lastly, the highest percentage of speed compliance was CP4 which is 75.50%, while CP12 owned the lowest percentage which is 1.59%.

Table 4.1.6: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Each Checkpoints on section 11.30am-12.30pm

Checkpoints (CP)	Critical statistical Measures				
	Mean	Mode	Median	Standard Deviation	Percentage of Compliance (%)
1	43.8618	41	43	6.992	0.92%
2	34.4821	34	34	7.9744	32.31%
3	41.4236	43	43	10.221	15.97%

4	28.2925	27	28	4.5229	73.58%
5	19.771	15	19	4.9885	20.61%
6	16.4091	12	15	4.9248	54.55%
7	28.8163	29	28	3.7417	77.55%
8	38.057	40	38	7.6309	12.44%
9	40.5397	40	40	5.2561	3.97%
10	38.5333	39	39	4.1022	5.71%
11	40.0682	42	40	4.4199	4.55%
12	33.3146	33	33	6.5861	33.71%
13	16.8471	16	17	4.5038	39.49%
14	14.9811	14	15	1.8963	60.38%
15	38.0294	38	38	5.4701	9.41%
16	34.8829	34	34	8.3956	34.23%

Table 4.1.6 of section 11.30am-12.30pm demonstrates that CP1 reached 43.86 km/h while CP3 reached 41.42 km/h and CP9 reached 40.54 km/h. Cars tend to violate speed limits if checkpoint mean speed exceeds the posted 30 km/h maximum. The observed speed violations indicate that the area experiences widespread disregard for traffic laws. Speeding is the prevalent behaviour among drivers because the observed speeds exceed the speed limit at both CP3 (43 km/h) and CP11 (42 km/h). The observed speeding behaviour at this checkpoint demonstrates that excessive speed has become standard practice there while numerous vehicles exceed the posted limit. Furthermore, the fact that CP1 (43 km/h) and CP3 (43 km/h) have median speeds greater than 30 km/h

suggests that over 50% of the cars are exceeding the speed limit. The median gives a more accurate representation of the behaviour of the average driver than the mean, which can be impacted by a few extreme results. The distribution or dispersion of speeds around the mean is then measured by the standard deviation. The greater speed range was incorporated in CP3 (10.22 km/h). Given the huge standard deviation, it is likely that many drivers are speeding, but there is also a range of behaviours - some may be far over the limit, while others may be closer to it or even below it. Many drivers are continuously exceeding the speed limit, as indicated by low standard deviations like CP14 (1.90 km/h), which suggests a pervasive and ongoing disrespect for the speed limit. Last but not least, CP7 had the highest speed compliance rate (77.55%), while CP1 had the lowest (0.92%).

Table 4.1.7: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Each Checkpoints on section 2.30pm-3.30pm

Checkpoints (CP)	Critical statistical Measures				
	Mean	Mode	Median	Standard Deviation	Percentage of Compliance (%)
1	37.3869	36	37	7.1379	15.33%
2	42.9432	50	44.5	8.664	10.23%
3	43.6173	44	44	7.3273	6.17%
4	39.0545	41	39	6.7509	11.82%

5	17.7333	17	17	4.9706	31.67%
6	15.6389	16	16	2.2188	47.22%
7	32.3298	32	32	5.7444	40.43%
8	39.75	40	40	6.2973	7.86%
9	42.5565	39	42	6.829	5.22%
10	35.4697	37	36	6.2097	22.73%
11	37.6306	38	37	6.0557	7.21%
12	38.5724	38	38	6.9679	8.55%
13	19.6716	19	20	2.3829	2.99%
14	15.6087	14	15	3.0857	52.17%
15	35.7468	39	37	5.9967	21.52%
16	32.8182	37	32	7.074	40.64%

The maximum mean speed recorded in Table 4.1.7 during section 2.30pm-3.30pm reaches 42.94 km/h for CP2 while CP3 achieves 43.62 km/h and CP9 maintains 42.56 km/h. A checkpoint exceeds the 30 km/h speed limit when its mean speed measurement indicates widespread vehicle speed violations. Speeding behaviour at this checkpoint represents a larger problem of traffic law violations within the community. The speed limit violations by cars are widespread based on the observed higher mode speeds recorded at CP2 (50 km/h) and CP3 (44 km/h). The checkpoint speed limit has become standard operating practice because numerous vehicles exceed the maximum speed. The median speeds of 44.5 km/h at CP2 and 44 km/h at CP3 exceed 30 km/h indicating that more than half of the cars are exceeding the speed limit. The median better represents typical driver behaviour compared to the mean because it avoids distortion from unusual results. Standard deviation serves to measure how speeds distribute themselves in relation to the mean value. The speed range in CP2 reached 8.66 km/h. A wide standard deviation indicates that numerous drivers exceed the speed limit, yet other drivers maintain speeds that are above or below the restriction. Many drivers are continuously exceeding the speed limit, as indicated by low standard deviations like CP6 (2.22 km/h), which suggests a pervasive and ongoing disrespect for the speed limit. Finally, CP14 had the greatest speed compliance percentage (52.17%), while CP13 had the lowest (2.99%).

Table 4.1.8: Mean, Mode, Median, Standard Deviation and Percentage of Compliance for Each Checkpoints on section 5.30pm-6.30pm

Checkpoints (CP)	Critical statistical Measures				
	Mean	Mode	Median	Standard Deviation	Percentage of Compliance (%)
1	50.3864	55	50.5	10.6182	3.41%
2	41	45	42	4.9889	2.17%
3	30.029	29	29	3.9144	62.32%
4	35.7468	39	37	5.9967	21.52%

5	22.4524	18	21	6.6193	7.14%
6	18.8125	18	18	3.1879	12.50%
7	28.5699	29	29	2.5272	85.48%
8	37.0856	40	38	5.2672	11.26%
9	31.9035	29	30	6.012	54.17%
10	44.1733	48	43	8.4843	2.00%
11	41.2609	38	40	5.2534	1.74%
12	40.2348	41	41	6.265	8.33%
13	17.2695	16	17	4.4076	36.17%
14	18.1042	20	18.5	3.315	20.83%
15	28.2925	27	28	4.5229	73.58%
16	37.0857	44	38	7.376	18.10%

The mean speed at CP1 during 5.30–6.30 p.m. reaches 50.39 km/h according to Table 4.1.8. The speed limit will be exceeded by vehicles when checkpoint mean speeds surpass 30 km/h. Local traffic law violations demonstrate a broader pattern of occurrences in the area. The operating speeds at CP1 (55 km/h) and CP10 (48 km/h) indicate most vehicles exceed the speed limit. The data shows that many vehicles exceed the speed limit in this area since speeding occurs regularly at this checkpoint. Furthermore, the fact that CP1

(50.5 km/h) and CP10 (43 km/h) have median speeds greater than 30 km/h suggests that over 50% of the cars are exceeding the speed limit. The median gives a more accurate representation of the behaviour of the average driver than the mean, which can be impacted by a few extreme results. The distribution or dispersion of speeds around the mean is then measured by the standard deviation. The greater speed range was incorporated in CP1 (10.62 km/h). Given the huge standard deviation, it is likely that many drivers are speeding, but there is also a range of behaviours—some may be far over the limit, while others may be closer to it or even below it. Most drivers are continuously exceeding the speed limit, as indicated by low standard deviations like CP7 (2.53 km/h), which suggests a pervasive and ongoing disrespect for the speed limit. Lastly, CP7 had the highest speed compliance rate (85.48%), while CP11 had the lowest rate (1.74%).

4.2 Inferential Analysis

The main objective of this inferential analysis is examining if there are statistically significant variations in the mean performance values recorded at different checkpoints (CP) on the main roads and parking areas. This study helps in determining if all checkpoints operate in a comparable manner or whether some display notably distinct behaviour that might call for operational review or managerial attention. The data summary for this ANOVA test for main roads shows below.

Table 4.2.1 Data Summary for Main Roads

Groups	*Count*	*Sum*	*Average*	*Variance*
CP 1	914	37615	41.15427	78.47015
CP 2	389	14400	37.01799	74.64658
CP 3	599	21007	35.07012	76.45661
CP 4	492	17245	35.05081	58.18682
CP 7	493	14578	29.56998	16.7578
CP 8	651	24830	38.14132	42.77692
CP 9	707	24855	35.15559	57.12873
CP 10	372	14833	39.87366	59.84114
CP 11	470	19370	41.21277	39.49834
CP 12	436	16627	38.13532	46.6782
CP 15	691	23019	33.31259	52.52823
CP 16	563	19560	34.74245	49.98871

Table 4.2.2 ANOVA test for main roads

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	73418.3	11	6674.391	119.879	1.00E-251	1.79006

Within Groups	376648.6	6765	55.67606			
Total	450066.9	6776				

Anova Test for Main Roads

1. State the null and alternative hypothesis.

$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_7 = \mu_8 = \mu_9 = \mu_{10} = \mu_{11} = \mu_{12} = \mu_{15} = \mu_{16}$

$H_0: At\ least\ one\ of\ \mu_i is\ difference$ $(i =$ 1,2,3,4,7,8,9,10,11,12,15,16)

2. State the significance level.

α = 0.05

3. State the statement of decision rule to determine the rejection region.

Decision Rule: Reject H_0 if Test Statistic > Upper Critical Value, otherwise do not reject

4. Find the critical value of the test from the statistical table.

Critical Value=1.79006

5. Determine the appropriate statistical technique and the test statistic to use.

Test Statistic=119.879

6. Make the comparison between test statistic value and critical value to make statistical decision.

Decision Making: Reject H_0 as Test Statistic > Upper Critical Value (119.879 > 1.79006)

7. Make conclusions.

There is sufficient evidence about the difference between checkpoint 1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 15, 16.

Based on the hypothesis above, there is enough statistical data to conclude that not all checkpoints on the main road have significantly different mean values; rather, some checkpoints have mean values that range significantly from one another as some checkpoints might have more traffic, slower processing, or different efficiency levels. In short, this means that not all the main roads checkpoints are equal.

Furthermore, here below is the ANOVA test conducted on parking areas.

Table 4.2.3 Data Summary for Parking Areas

Groups	*Count*	*Sum*	*Average*	*Variance*
CP 5	341	6807	19.96188	24.12501
CP 6	169	2964	17.53846	16.58333
CP 13	375	6579	17.544	17.9653
CP 14	137	2215	16.16788	9.537784

Table 4.2.4 ANOVA test for parking areas

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1858.387	3	619.4622	33.18198	1.83E-20	2.613646
Within Groups	19004.67	1018	18.66863			
Total	20863.05	1021				

Anova Test for Parking

1. State the null and alternative hypothesis.

$H_0: \mu_5 = \mu_6 = \mu_{13} = \mu_{14}$

$H_0: At\ least\ one\ of\ \mu_i is\ difference\ (i = 5, 6, 13, 14)$

2. State the significance level.

α = 0.05

3. State the statement of decision rule to determine the rejection region.

Decision Rule: Reject H_0 if Test Statistic > Upper Critical Value, otherwise do not reject

4. Find the critical value of the test from the statistical table.

Critical Value= 2.613646

5. Determine the appropriate statistical technique and the test statistic to use.

Test Statistic= 33.18198

6. Make the comparison between test statistic value and critical value to make statistical decision.

Decision Making: Reject H_0 as Test Statistic > Upper Critical Value (33.18198 > 2.613646)

7. Make conclusions.

There is sufficient evidence about the difference between checkpoint 5, 6, 13, 14.

Based on the ANOVA tested above for parking areas, there is enough statistical evidence at the 0.05 significance level to conclude that at least one parking area (CP5, CP6, CP13 and CP14) has a significantly different means. This also shows that some parking areas might be more crowded, more efficient, or better managed than others. Thus, it leads to the unequal between parking area checkpoints.

Chapter 5 Discussions, Recommendations, Conclusions

5.0 Introduction

The chapter presents a thorough examination of research findings while answering the research questions first introduced in Chapter One. The study examines its results in detail before exploring meaningful outcomes and discussing research constraints. The discussion includes essential recommendations for future research projects alongside a complete examination of the study's essential value. The discussion provides fundamental groundwork for additional scholarly research while sustaining current field discussions.

5.1 Recapitulation of Study

The purpose of this study was to investigate the speed compliance of vehicles passing through the 16 identified checkpoints Universiti Tunku Abdul Rahman (UTAR) Kampar Campus, primarily on straight road. Road safety in the campus has grown more crucial because UTAR Kampar campus is a sizable educational site that accommodates a significant number of staff and students that commute daily in a variety of vehicles. Straight roads are potential hotspots for speeding violation because of their unobstructed, linear design which encourages faster vehicle speeds. Apart from that, the curvy roads at the campus are also considered as a hazard due to the issues such as less visibility during turning.

The primary objective of this study was to investigate whether vehicles in campus that travel on straight roads comply with the posted speed limit which is 30 km/h on main roads and 15 km/h on parking zones. To give a more comprehensive picture of driving behaviour in UTAR Kampar Campus, this study also considerate other campus zones such as curvy roads and parking areas.

Apart from that, this study also considered on zones where traffic calming methods were implemented in the campus.

Quantitative method of study was implemented in this study, where vehicle speeds were measured using a radar speed gun primarily on straight road and some curvy road in UTAR Kampar Campus. To guarantee accuracy and variability, the data were gathered in 32 days at 16 checkpoints during both peak and off-peak hours.

The results showed that a significant percentage of vehicles did not comply to the speed limit in the campus which is 30km/h, especially on longer, straighter sections. Additionally, higher rates of non-compliance vehicles were also a result of the insufficient number of traffic-calming measures like speed bumps or signage.

5.2 Discussion of Findings

5.2.1 Research Question 1:

What is the percentage of vehicles in UTAR Kampar that complies the speed limit?

To answer this question, the data has been segregated into few sections which is according to the time zone of the experiment and both main road zones and parking zones.

Table 5.2.1: Percentage of Compliance for Each Checkpoints on session 7.30am-8.30am (Main Road)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
1	64 out of 472	13.56%
2	17 out of 60	28.33%
3	179 out of 305	58.69%
4	114 out of 151	75.50%
7	44 out of 66	66.67%
8	14 out of 96	14.58%
9	5 out of 10	50.00%
10	12 out of 51	23.53%
11	3 out of 156	1.92%
12	1 out of 63	1.59%

15	57 out of 252	31.75%
16	30 out of 160	18.75%

Table 5.2.1 is showing the percentage of vehicles that complied with the speed of 30 KM/H at the main road zones for the time frame of 7.30am to 8.30am. From this table, it is noticeable that the vehicles that pass-through CP 12 which is from Block H to Eastgate at the time zone of 7.30am – 8.30am are the least compliant to the speed limit. Only one car out of 63 cars has complied with the speed limit. On the other hand, vehicles that pass-through CP 4 which is Eastgate to Block H has been seen having a good compliance percentage of 75.5% which is 114 out of 151 cars are compliant with the speed limit.

Table 5.2.2: Percentage of Compliance for Each Checkpoints on session 7.30am-8.30am (Parking Zone)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
5	6 out of 108	5.56%
6	25 out of 95	26.32%

13	10 out of 25	10.00%
14	13 out of 19	61.54%

When it comes to the parking zones in the morning session it has been considering that the vehicles passing through CP 5 which is the zone where car enter Block H parking zone least comply with the speed limit of the parking zones which is 15 KM/H. This may be due the factor of students/staffs rushing to get the parking spots to get into classes or work. On the other hand, CP 14 which is the exiting zone of Block A parking has the highest number of cars compliant to the speed limit of the parking zones.

Table 5.2.3: Percentage of Compliance for Each Checkpoints on section 11.30am-12.30pm (Main Road)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
1	2 out of 217	0.92%
2	63 out of 195	32.31%
3	23 out of 144	15.97%

4	5 out of 152	73.58%
7	114 out of 147	77.55%
8	24 out of 193	12.44%
9	5 out of 126	3.97%
10	6 out of 105	5.71%
11	4 out of 88	4.55%
12	30 out of 89	33.71%
15	16 out of 170	9.41%
16	38 out of 111	34.23%

According to Table 5.2.3, which is showing the percentage of vehicles that complied with the speed of 30 KM/H at the main road zones for the time frame of 11.30am to 12.30pm, we clearly see that the vehicles in CP 1 which is Westgate to Block P, did not comply with the speed limit in the campus. A disappointing percentage of 0.92% of the vehicles which passed through that zone complied with the speed limit. On the other hand, the most compliant with the speed limit in the time zone of 11.30am to 12.30pm is the vehicles that passed through CP 7 which is Block L inner ring road. The compliant percentage is 77.55% which is 114 out of 147 cars obeyed the speed limit.

Table 5.2.4: Percentage of Compliance for Each Checkpoints on section 11.30am-12.30pm (Parking Zone)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
5	27 out of 131	20.61%
6	12 out of 22	54.55%
13	62 out of 157	39.49%
14	32 out of 53	60.38%

When it comes to the parking zones for the time zone of 11.30am to 12.30pm, we can see that a lot of cars which passed through the CP 14 which is Block A (exiting) is compliant to the speed limit of parking zone. The percentage of the number of cars complied is 60.38% which is high. Other than that, it is also noticeable that the least compliant to the speed limit of parking zone in the time of 11.30am to 12.30pm is the cars passing through CP 5 which is the Block H parking (entrance).

Table 5.2.5: Percentage of Compliance for Each Checkpoints on section 2.30pm-3.30pm (Main Road)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
1	21 out of 137	15.33%
2	9 out of 88	10.23%
3	5 out of 81	6.17%
4	13 out of 110	11.82%
7	38 out of 94	40.43%
8	11 out of 140	7.86%
9	6 out of 115	5.22%
10	15 out of 66	22.73%
11	8 out of 111	7.21%
12	13 out of 152	8.55%
15	95 out of 163	21.52%
16	76 out of 187	40.64%

Table 5.2.5 is showing the percentage of vehicles that complied with the speed of 30 KM/H at the main road zones for the time frame of 2.30pm to 3.3pm. When vehicles pass through CP 7, which is the Block L inner ring road, the compliance level is the highest out of all the other checkpoints which is 40.43%. This indicates that the drivers are slowing down when they pass through the narrow road. On the contrary, the vehicles that pass-through CP 9, which is the route from Block P to Westgate showed minimal compliance to the speed limit which is only 5.22% of compliance.

Table 5.2.6: Percentage of Compliance for Each Checkpoints on session 2.30pm-3.30pm (Parking Zone)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
5	19 out of 60	31.67%
6	17 out of 36	47.22%
13	2 out of 67	2.99%
14	12 out of 23	52.17%

When it comes to the parking zones for the time zone of 2.30pm to 3.30pm, we can see that more than half of the cars (52.17%) passing through CP 14 which is the Block A parking exit is complying the parking zone speed limit. On the other hand, only 2.99% of vehicles passing through CP 13 which is the Block H parking zone exit has complied with the speed limit.

Table 5.2.7: Percentage of Compliance for Each Checkpoints on session 5.30pm-6.30pm (Main Road)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
1	3 out of 88	3.41%
2	1 out of 46	2.17%
3	43 out of 69	62.32%
4	17 out of 79	21.52%
7	159 out of 186	85.48%
8	25 out of 222	11.26%
9	247 out of 456	54.17%
10	3 out of 150	2.00%

11	2 out of 115	1.74%
12	11 out of 132	8.33%
15	78 out of 106	73.58%
16	19 out of 105	18.10%

In Table 5.2.7, we can see that most of the cars that went through CP 7 which is the Block L inner ring, has a high percentage of compliance is at 85.48%. This clearly shows that drivers slow down a lot when they are passing through narrow roads. In contrast, only 3 out of 150 drivers passing through CP 10 which is Block A to Westgate has adhered to the speed limit. The most disappointing part is that the highest speed in that zone is 96 KM/H.

Table 5.2.8: Percentage of Compliance and Highest Speed for Each Checkpoints on section 5.30pm-6.30pm (Parking Zones)

Checkpoints (CP)	Statistical Measures	
	Number of compliances	Percentage of Compliance (%)
5	3 out of 42	7.14%
6	2 out of 16	12.50%

13	51 out of 141	36.17%
14	10 out of 48	20.83%

As for the parking zone on evening session, we can see that CP 5 has the least compliant percentage which is 7.14%. This shows that less car are complying with the speed limit of 15 KM/H and the highest speed in that is 49 KM/H. On the other hand, only 36.17% of vehicles passing through CP 13 which in Block H parking zone exit has complied with the speed limit. The highest speed limit is 28 KM/H.

5.2.2 Research Question 2:

In which zones do the vehicles tend to speed up more?

There are 3 specific zones where vehicles tend to speed up more in the main road and 1 specific zone in the parking zone where the speed of the vehicle is significantly higher than the other parking zones.

Table 5.2.9: Top 3 zones where vehicles speed up (Main Road)

Checkpoint (CP)	Time Zone	Mean Speed (KM/H)
CP 1	5.30pm – 6.30pm	50.39
CP 11	7.30am – 8.30am	44.37

CP 10	5.30pm – 6.30pm	44.17

According to the table, vehicles tend to speed up at CP1 which is Westgate to Block P. In this zone, especially during the evening time where that route has minimal number of cars as it a route used to entering UTAR and not exiting. The mean speed in that zone is at 50.39 KM/H which is very high compared to the allowed speed limit of 30 KM/H. The second highest zone where vehicles tend to speed up more is CP 11 which is Block B to Block A where the mean speed is 44.37 KM/H. This might be due to the factor that road will be rarely used in the morning session as that route will be used to exit UTAR as well. Finally, not being far from the second highest zone, the third highest zone has a mean speed of 44.17 KM/H. This speed was recorded at CP 10 which is the route from Block A to Westgate.

Table 5.2.10: Top zones where vehicles speed up (Parking Zone)

Checkpoint (CP)	Time Zone	Mean Speed (KM/H)
CP 5	5.30pm – 6.30pm	22.45

In CP 5 which is the Block H parking zone (Entrance), it is noticeable that the mean speed is 22.45 KM/H at the time frame of 5.30pm to 6.30pm. This is due to the fact that drivers might be rushing home as they want to reach their home faster and spend more time with their family and friends.

5.2.3 Research Question 3:

What are the ways used in the campus to slow vehicles down?

In this research, it has tested vehicles' speed on main roads and parking areas in Universiti Tunku Abdul Rahman (UTAR). Vehicle speeds were measured at 16 checkpoints spread throughout the campus, including parking lots and major roads, as part of this study. To ensure an extensive understanding of traffic behaviour throughout the day, these observations were carried out in four separate time zone.

The findings show that speed bumps and rumble strips are the two main physical traffic-calming techniques used inside UTAR Kampar campus. These are typical traffic-calming techniques used all throughout the world to reduce vehicle speed, especially in places like university campuses where there are a lot of pedestrians walking along the campus.

Speed bumps are elevated patches of pavement intended to considerably reduce vehicle speed. They are highly effective at lowering vehicle speed when positioned and configured correctly, particularly in parking lots and residential areas, The Federal Highway Administration (FHWA) claims that data gathered at 26 speed bumps shows that there is a significant impact on fast-moving cars. At least 16 km/h over the legal speed limit was the recorded speed for 14% of the pre-implementation traffic at the research sites (Module 4: Effects of Traffic Calming Measures on Motor Vehicle Speed and Volume, n.d.). This high-speed traffic decreased to an average of 1% of the overall traffic after a speed bump was installed. Speed bumps are positioned thoughtfully at crossroads and close to pedestrian crossings in UTAR to force drivers to slow down and lower the chance of collisions. Based on our speed data, CP15 is a road with speed bumps has achieved a percentage of 73.58% speed compliance fulfilment rate.

However, rumble strips are grooved or textured patterns on the road surface that, when they come into contact with the driver, it will generate vibratory and audible feedback. These are usually used to warn distracted drivers and urge them to slow down, particularly when they are getting close to high-risk areas like junctions or pedestrian walkways. According to a study of Adruce and Stephen (2020), installing Lane Departure Warning Systems, such as Centreline Rumble Strips (CLRS) and Shoulder Rumble Strips (SRS), can decrease opposite-direction head-on crashes and run-off-road crashes, which account for a sizable percentage of road crashes in Malaysia. Based on our speed data, CP7 with rumble strips has achieved a total percentage of 85.48% of speed compliance fulfilment rate.

In addition to lowering speed, these traffic-calming measures are essential for encouraging a responsible and safe driving culture inside UTAR Kampar campus. Appropriate placement, design, and upkeep are critical to their efficacy. The implementation of such safeguards at UTAR is indicative of the university's dedication to student welfare and road safety.

5.3 Implications of Study

Throughout the investigation, three distinct road types are seen on campus: straight, curved, and narrow roadways. Nevertheless, none of the cars meet the speed compliance standards set out by DSS (Department of Safety and Security). The speed limits at all 16 checkpoints needed qualification to cover both main road and parking area use. The width of the road determines the deceleration rate which affects driver behaviour since pedestrians and bike users are present along the road and represent a high risk of accidents. On the other hand, higher deceleration rates result from the road's unrestricted width. However, upon observation of the data, it is evident that parking areas yield the most optimal results. Parking areas are more effective in reducing vehicle speeds before entering the checkpoint, with a percentage of compliance of 28.28 %, compared to 26.72% for the main road. Additionally, the Anova Test enables speed comparison between all checkpoints while demonstrating that both the main road and the parking areas represent the most insignificant differences within the campus.

The advised speed range for approaching campus areas stands at 15 to 20 km/h to reduce both vehicle destruction and accidents. Following DSS guidelines for speed limit restrictions will help the institution both achieve its desired effectiveness as well as promote safer driving conditions. Since speed limits have a direct influence on campus safety, authorization should be strictly supervised based on data collected about driver behaviour. Additionally, the organization must make the signs that indicate the pedestrian lane clear so that vehicles know to slow down. Moreover, significant system helps to identify locations where speeding occurs to create targeted safety measures which decrease crashes while safeguarding pedestrians in busy pedestrian zones. If these conditions are not fulfilled, accidents might occur at any time.

During the study, certain changes were discovered that should be considered by future researchers when doing similar studies. It was specifically found that the vast number of cars would affect the radar speed gun's accuracy since it was not quick enough to continuously detect for data collection. Additionally, the height at which the gun is placed was also found to be necessary to set up accordingly. As long as the speed gun is pointing at the exact angle of the moving item and is not malfunctioning because of an error sensor, it may detect the speed of an object or automobile when it reaches a particular distance. This is because the speed gun measures speed depending on the angle of the object. Therefore, the speed gun may be positioned on the tripod at a height of 155 cm and at a 90-degree angle perpendicular to the face of the vehicle.

5.4 Limitations

5.4.1 Driver's Awareness Raised during experiment

When the experiment was conducted, the group members were wearing high resolution safety vest as a standard safety procedure. But this has brought curiosity to the drivers passing by the experiment zone which caused them to be more vigilant and be aware of their surroundings. This is because they might have assumed that the people from the Department of Safety and Security (DSS) are conducting an operation. Apart from that, the curiosity also made some drivers to pass by slowly in order they can ask the team members what is happening. These actions caused them to drive slower and brake when passing through the experiment zones. This has affected the data collected as the accuracy of the data collected is not in the optimal level.

5.4.2 Speed Gun's functional level during different weather conditions

It also has been notable that the speed gun's capturing ability is reduced when it is raining. This is because the frequency of the speed gun will be interfered when it is raining causing the speed captured to not be accurate or the worst-case scenario is that the speed cannot be captured at all. But this problem only occurs during heavy rain as during light rain, the radar still can penetrate through the rainwater. Hence, the accuracy of the data is slightly affected by this but still the validity of the data is still considered high.

5.4.3 Repetition of same cars

During experiment at checkpoint (CP) 5, 6,13 and 14, it was noted that a lot of drivers were driving around the parking lot few many times as they were looking for a parking spot. This made them to pass the experiment zone a lot of times. This has affected the accuracy of the data in a way that it causes unnecessary repetition of data. For instance, when experiment is being conducted at a non-peak hour where less cars are expected, the cars which repeatedly pass the capturing zone will increase the number of cars recorded which then later on affect the accuracy of the data in that time zone. Even though this might not be an issue, this plays an important role when it comes to the authenticity of data during that time zone as it may cause abnormal number of cars in that time zone.

5.5 Recommendations

5.5.1 Recommendations for future research

It is recommended that in the future study, the research team shall find a more subtle way to record the speed of the vehicles so that the risk of drivers slowing down or stopping out of curiosity can be reduced. This is because when the speed is recorded in a way that the drivers cannot notice the ongoing experiment, the data collected will be more accurate and more authentic. For instance, the researchers can use a camouflage suit when doing the experiment so that it will not be too obvious that they are recording data. Another way of recording data in a subtle way is that the researchers can stand further away from the road or try to stay behind objects such as trees or bushes. This will reduce the chances of drivers noticing anything which then will not influence the speed data. But the downside of this method is that, if the researchers are standing too far away, the speed cannot be captured due to the low frequency or interference of frequency.

It is also recommended that apart from only recording the speed of vehicles, researchers should also record the vehicle registration number plate of the road users during the experiment time. This is to eliminate the repetition of same car going through the experimental zone multiple times so that the data recorded will be reasonable according to the time zone of the experiment. Apart from that, researchers can also immediately report roads users who drive dangerously fast in the campus to the authorities so that immediate actions can be taken.

5.5.2 Recommendation for improving current situation

It is recommended that UTAR should take more speed calming methods to reduce the speed of the vehicles inside of the campus. The Department of Safety and Security (DSS) could propose to increase the number of speed bumps and rumble in some of the experiment checkpoints as the speed of those zones are too dangerous. For instance, it is noticeable that at CP 1 and CP 9 which is from Westgate to Block P and vice versa, the average speed of the vehicles is very high. The highest mean speed of that zone is 50.39 KM/H which is very high considering the speed limit in that zone is 30 KM/H. Hence, to minimize the repetition of this driving behaviour, it is recommended to add rumble strips or speed bump in that location.

Apart from that, it is also recommended for the DSS to use speed gun with number plate detection system so that it will boost the opportunity to catch the wrongdoers in campus. For instance, the DSS should have random speed trap operation in campus from time to time and it is recommended to use the speed gun which has number plate scanner as well so that the DSS can take the necessary actions against the drivers. Some of the actions include confiscating the vehicle sticker and blacklisting the car from entering the campus for one semester. These stern actions will cause awareness among the drivers in the campus and ensure that they do not break the law and mitigate the risk of accidents due to over speeding. Apart from that, DSS may also consider changing the speed limit of the campus to 40 km/h as the mean speed result according to the research is is 36.59 km/h.

5.6 Conclusion

In conclusion, this research aimed to examine the speed compliance of vehicles inside of UTAR Kampar campus. This study has showed that there are certain zones in UTAR Kampar campus where the speed limit is not being complied which increases risk of accidents due to the speed. The result shows that the mean speed in the UTAR Kampar campus is 36.59 KM/H considering that the allowed speed limit in campus is 30 KM/H. Apart from that, the speed compliance level of the drivers in the campus is also very low. A disappointing percentage of 26.72% was the general compliance level of the drivers in the campus. This is a very serious thing to take note as this is regarding the safety of the people inside of the campus. It is recommended that the DSS should take necessary actions (refer to 5.5.3) to control this problem and mitigate the risk of accidents happening due to the speeding.

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