VEHICLE – PEDESTRIAN CONFLICT: A CASE STUDY IN UNIVERSITI PUTRA MALAYSIA

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Abstract

Vehicle-pedestrian conflict is a commonly unsafe event that occurs in both urban and rural areas, especially in developing countries. It is still an open research topic, mostly in traffic safety and urban planning, which is utilised for evaluating the behaviours of vehicles and pedestrians at a non-signalised marked walkway. Three stations were selected based on higher daily activities to calculate the regularity of pedestrian movement. A manual calculation method was applied, and the calculation was done only during the daytime. Three different teams were formed to obtain the measurements at the three different sampling points simultaneously. A present study on preliminary vehicle-pedestrian conflict reveals the frequency of pedestrians in a concentrated area and its Level of Service (LOS) in Universiti Putra Malaysia (UPM) Serdang. The findings show that rush hour occurs during the mid-day in weekday, when students have finished their classes and adults have gone out for other businesses.

Keywords: campus, pedestrian, non-motorised vehicle, shared pathway

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INTRODUCTION

Urban areas, especially in developing countries, commonly have mixed traffic flows (Ni, Wang, Sun, & Li, 2016). In this approach of mixed traffic, motor vehicles, non-motorised vehicles (bicycles) and pedestrians share the same space (roads and intersections), which in turn triggers conflicts (Almodfer, Xiong, Fang, Kong, & Zheng, 2016). These vehicle-vehicle conflicts, bicycle-vehicle conflicts, and pedestrian-vehicle conflicts occur frequently, with vehicle-pedestrian conflicts being the most concerning issue.

The behaviour of pedestrians and drivers can become a great influence, which depends on many uncertain factors (Suzuki & Ito, 2017). For example, pedestrians and cyclists may step out onto the road without warning and sometimes are unaware or being less alert around traffic, which present risk of collision with vehicles. Besides that, the millennial generation tends to obsess over their smart phones, texting or talking and being seemingly ignorant of their surroundings (Cloutier et. al., 2017). On the other hand, drivers of motorised vehicles could also be using their smart phones while driving, compromising their attention to the road. Policy and decision makers around the world have typically prioritised the safety of pedestrians (Iryo-Asano & Alhajyaseen, 2017). However, these intentions get less attention due to increasing vehicle congestion in urban areas. Additionally, pedestrian areas have been minimised to allow for better road openings.

Pedestrians are vulnerable road users because of their unprotected safety on the road (Zheng, Chase, Elefteriadou, Schroeder, & Sisiopiku, 2015). In Malaysia, more than 6,000 cases involving pedestrian injuries and fatalities on the road are reported annually. Meanwhile, pedestrian fatalities are averages at 500 deaths each year (Mohd Syazwan, Baba, Nur Zarifah, Aqbal Hafeez, & Noor Faradila, 2017). Most injuries involve the elderly (60 years above), and >60% of these accidents occurred on straight roads. The fatality statistics of pedestrians has been showing a continued increase from 24.4% in 2006 to 44.2% in 2013, and thus needs to be attended to. Table 1 shows the fatalities involving pedestrians in Southeast Asian countries.

Universiti Putra Malaysia (UPM) has set a new record when it was listed as the world's top 17th university in the UI-Greenmetric World University Ranking based on its rigorous efforts to promote campus sustainability and effective environmental management. In year 2013, UPM established a cycling space for the students to cycle in the campus as part of its green campus initiative. This benefits the students by improving air quality, minimising pollution and road damage, and promotes healthy living. This could also reduce the frequencies of bus service within the campus. These bicycle lanes have been built on the existing roads, which are also being used by other vehicles. The bicycle lanes themselves are shared with pedestrian.

Table 1 Pedestrian causalities in Southeast Asian countries in 2015

Southeast Asian Country	Reported Road traffic Fatalities (Count)	Death by Pedestrian Category (Percentage)
Laos DPR	910	10%
Malaysia	6,915	7%
Myanmar	3,612	26%
Philippines	1,513	19%
Singapore	159	27%
Thailand	14,059	8%
Vietnam	9,156	-
Cambodia	1,950	13%
Brunei	54	9.20%
Indonesia	26,460	21%
Timor-Leste	74	-

Source: Modified from Mohd Syazwan et al. (2017)

UPM has made significant improvements, particularly in the sectors of transport and infrastructure, such as the size of available green space, the use of efficient energy-saving facilities and bicycles within the campus area. However, in terms of pedestrian and cyclist space there are still some issues regarding both groups, especially with regards to the shared pathway with motorised vehicles. Vehicle-pedestrian/cyclist interactions are commonly inter-related with traffic safety. In addition, the shared pathways between both parties could increase interaction conflict. Pedestrian and cyclist safety is also an important matter, especially at night. Low light conditions add difficulties for the visibility of both vehicles and pedestrians/cyclists (King, Wood, Lacherez, & Marszalek, 2012). Neglecting the necessary dimensions could cause injuries to the pedestrian/cyclist. Hence, important measures should be in place to ensure pedestrian/cyclist safety on walkways and cycling lanes.

This paper intends to contribute to the existing body of knowledge in terms of, firstly, quantifying pedestrian frequency in the study are, and secondly, evaluating the Level of Service (LOS) as well as exploring the factor of pedestrian-vehicle conflicts.

RESEARCH BACKGROUND
This study is based on the observational method (counted measurement) and data was collected using the manual count method. The study sites chosen are situated at three (3) intersections in the north campus of Universiti Putra Malaysia; namely V1 - Junction at Persiaran Tulang Daing (CIMB Bank), V2 - Junction at Persiaran Tulang Daing (Faculty of Forestry) and V3 - Junction at Persiaran Asam Jawa (Faculty of Educational Studies) (Figure 1). These sites were selected as they are considered high density areas with a high capacity of pedestrian activities.
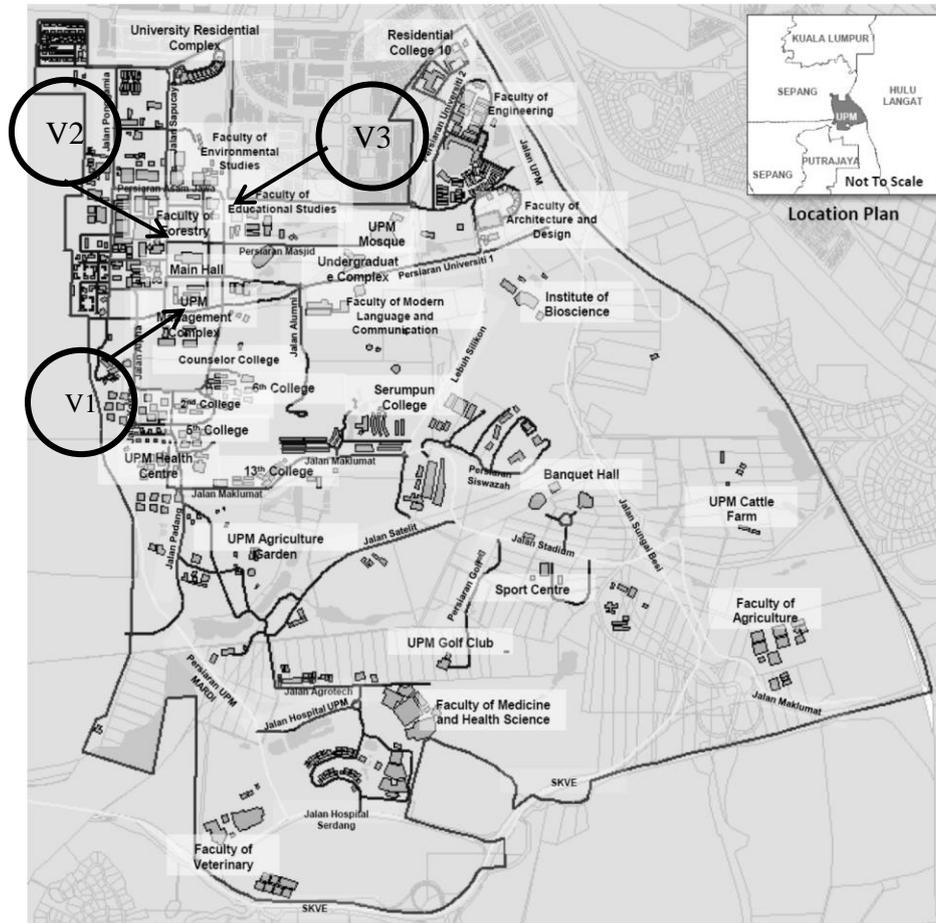
Figure 1 The study area is located at the north campus in Universiti Putra Malaysia.

The pedestrian volume counter was used to determine the volume of pedestrians using a walkway or crossing a street either at a signalised or non-signalised intersection. Normally, pedestrian volume counts at each walkway should be made during the same period as the vehicle volume count. Tallies should also be made during the same periods as the vehicle volume count.

The pedestrian data collection processes started with pre-site survey preparation, where all the equipment, such as manual counter, safety jacket and tally sheet, was prepared. Then, sampling points were selected by selecting locations with a clear view of the pedestrian walk, and was safe and away from danger. Next, by using the tally sheet, each data collected was filled in and merged with other data at the end of the sampling day. Data collection in every area was carried out by an assigned team member at a pre-determined site. The observations were conducted during the day of three (3) days, day 1 (Thursday),

day 2 (Friday) and day 3 (Saturday) – from 0800 to 1900 – at intervals of 15 minutes. Once a complete set of data was obtained, analyses were carried out using the Statistical Package for Social Science and the results were evaluated to identify the Level of Service (LOS).

RESULTS AND DISCUSSION

Pedestrian volume

Each sampling point consists of three (3) different junctions, namely D1, D2 and D3 (Figure 2). The pedestrian frequency analysis explains the total number of pedestrians at a designated time. The results of three (3) days sampling are summarized in Figure 2. Station V1 has the higher volume of pedestrians in day 1 which occurred at mid-day with a total of 758 pedestrians while total pedestrians for a day are 2904. This number is expected to be high as people were going out for lunch and other businesses as this area is where the bank, food court and the road to students' residences are located. Meanwhile, station V2 has a different pattern as this area consists of faculty buildings and the main library across the road. Usually, students would complete their classes and walk to the library or the bus stop at mid-day and during the evening. The average total volume of pedestrians over the course of one day was 664 and the highest volumes of pedestrians were recorded on day 2 with 1071. At station V3, pedestrians usually walk by to reach the Faculty of Education and Lecture Hall beside the parking lot. Only certain students involved in classes in the Lecture Hall would walk to this area. Lecture times are usually packed from morning to afternoon and reduced in the evening, with a total average of pedestrians of 659, 246 and 54 during 3 days sampling periods respectively. The summary of pedestrian volume is as shown in Figure 2.

The Highway Capacity Manual (HCM) uses LOS as a qualitative measure to describe operational conditions of pedestrian circulation. The HCM's method for analysing pedestrian LOS is based on the measurement of pedestrian flow rate and sidewalk space. For this survey, pedestrian queuing LOS was used as a standard to measure pedestrian LOS because the flow pattern for pedestrian is quite similar to that of queuing. Table 2 below shows the LOS criteria for pedestrian.

The LOS output shows that the LOS value varies in spatial and temporal scale. Station V1 indicate of 88% of LOS output is F (day 1), which is described as "standing, where virtually all persons are standing in direct physical contact with others and no movement is possible in the queue". This is because at this moment, most pedestrians use this route during the given time and the space along the pedestrian route is only 3.1m wide. In day 2, station V1 experienced moderate LOS with 29% of A and D criteria and 100% of A criterion in day 3. Meanwhile, station V2 was observed with steady LOS in day 1 where the LOS having 38%

of D and F criteria. Comparatively, day 2 and day 3 having highest LOS of F and A criteria with 54% and 83% respectively.

For station V3, the highest LOS for day 1 and 3 are A criterion with 42% and 100% respectively showing the description of "Standing and free circulation through the queuing area is possible without disturbing others within the queue". Day 2 for station V3 showing an average condition of LOS with 29% of criteria A and D for the reason of different time period. Furthermore, Day 2 of the survey was conducted on a Friday, where most of the male students are performing the Friday prayers.

Day 3 of sampling campaign shows low pattern of movement in each station. This is because most of undergraduate student stayed in the residential area but only certain students that enrolled in credited co-curricular activities or postgraduate students having their classes in the main campus are using the pedestrian walkway.
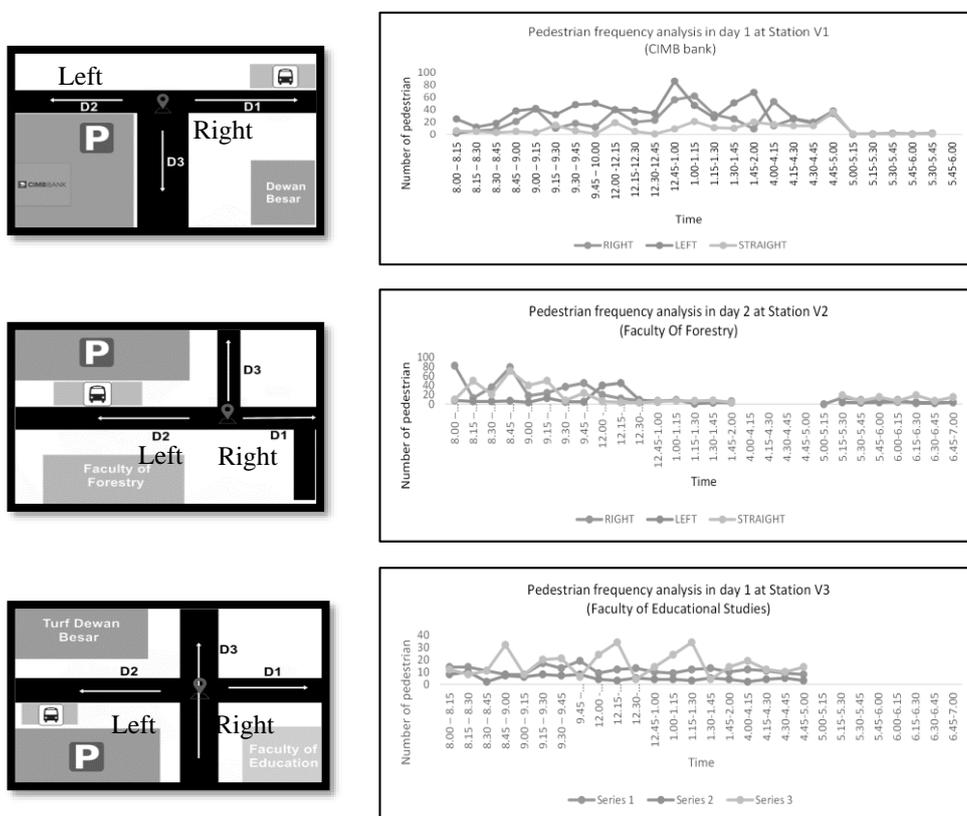

Figure 2 Summary of highest pedestrian volume (left) & summary of pedestrian volume (right)

Table 2 Level of service criteria for pedestrian

Station	Day 1 (Thurs)				Day 2 (Fri)				Day 3 (Sat)			
	Time											
	0800 - 1000	1200 - 1400	1600 - 1800	Total pedestrian /hr	0800 - 1000	1200 - 1400	1600 - 1800	Total pedestrian /hr	0800 - 1000	1200 - 1400	1600 - 1800	Total pedestrian /hr
V1	427	755	305	**1487**	356	128	105	589	39	47	35	121
V2	235	282	241	758	662	231	178	**1071**	69	53	41	163
V3	278	272	109	**659**	29	82	135	246	18	18	18	54
Total				2904				1906				338

LOS	Average Space (m²/p)	Description
A	>1.2	Standing and free circulation through the queuing area is possible without disturbing others within the queue.
B	>0.9-1.2	Standing and partially restricted circulation to avoid disturbing others in the queue is possible.
C	>0.6-0.9	Standing and restricted circulation through the queuing area by disturbing others in the queue is possible.
D	>0.3- 0.6	Standing without touching is possible; circulation is severely restricted within the queue and forward movement is only possible as a group.
E	>0.2- 0.3	Standing in physical contact with others is unavoidable; circulation in the queue is not possible; queuing can only be sustained for a short period without serious discomfort.
F	≤ 0.2	Standing virtually all persons within the standing in direct physical contact with others and no movement is possible in the queue.

Table 3 Summary of Level of Service (LOS) in 3 days for each station

Station	Day 1 (Thurs)		Day 2 (Firi)		Day 3 (Sat)
V1	D = 4%		A = 29%	D = 29%	A = 100%
	E = 8%		B = 4%	E = 10%	
	F = 88%		C = 14%	F = 14%	
V2	A = 4%	E = 16%	C = 18%	F = 54%	A = 83%
	C = 4%	F = 38%	D = 18%		B = 13%
	D = 38%		E = 10%		D = 4%
V3	A = 42%	D = 13%	A = 29%	D = 29%	A = 100%
	B = 4%	E = 25%	B = 4%	E = 10%	
	C = 8%	F = 8%	C = 14%	F = 14%	

CONCLUSION

In this study, by using the data collected from three stations, the pedestrian volume pattern was generated. The distribution of pedestrian varies between spatial and temporal measurement. The highest contribution of pedestrian volume is during weekday where most of the students will be around the main campus for lecture time. It also indicates that most of the students will be concentrated in an area of lecture hall and library. From the findings, the Level of Services (LOS) were measured. The LOS criteria also strongly depend on the spatial and temporal distribution as for present study, most of the station experience criterion F during weekday which explains issues on crowd and congestion while criterion A during weekend.

Based on the output, the preliminary data can be used to explore diverse and complex pedestrian-vehicle interactions and pair these with sufficient considerations when evaluating pedestrian safety. In the future, the development of walkway designs and the addition of safety and visibility features can reduce the probability of interactions between crossing pedestrians and vehicles. Awareness of both drivers and pedestrians to respect each other's space requires an understanding of where, between whom, and under what circumstances interactions can occur. Such an approach can also help identify which engineering, urban design and enforcement programs are needed to ensure safe pedestrian crossings for all ages.

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