DATA ANALYSIS OFF THE ROAD SAFETY IN THE CITY CENTRE

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Abstract

Due to massive increase of using of different types of city transport e.g. cars, bicycles, segways, scooters, or electric scooters also increases the potential risk of collisions or critical situations. These risks may be caused by the undisciplined drivers or exceeding of maximal allowed speed on the city roads. All these factors can affect transport safety in the city, especially for the most vulnerable road users like pedestrians, bikers, or scooter riders.

In our research, we decided to find out the speed conditions and the speed limits exceeded by the passenger car drivers, van drivers, and long vehicle drivers. Our traffic sensor network consists of 26 traffic intensity sensors placed in strategic places around the city center of Zilina city and the sensor network covers all the road lines. The sensors can count input and output traffic and also measures the speed of the vehicles crossing the sensors. The major group of traffic sensors is placed near the pedestrian crossroads, so we can detect the exceeding the speed in the most dangerous places for pedestrians or cyclists in the city. Since we have diversified data, we can compare places near and far from pedestrian roads.

Keywords: Road safety, traffic sensors network, vehicle speed, Zilina city

1. INTRODUCTION

In this article, the data evaluation of city traffic safety in the Slovak county city Zilina is described. The data are collected from 26 traffic sensors placed in the main input and output road lines to the Zilina city center. The wireless traffic sensors are inbuilt into the asphalt construction of the road covered by the layer of liquid asphalt. The 9 battery-powered traffic gates were mounted into the roads as described before and they are almost invisible to see, and they do not affect the appearance or quality of the roadway. The map of traffic sensors placed in the city is shown in **Figure 1**. The sensors can detect the traffic volume of incoming and outcoming vehicles, the speed of transiting vehicles, and the category of these vehicles. The live data from traffic sensors are cyclically collected by the LoRaWAN wireless interface every 5 minutes so we can consider the sampling frequency of these data is enough for this purpose. The data are sequentially saved into the database whereas this database is completely free of charge and available for wide public purposes on the web page www.clevernet.sk. Another group of sensors installed in the Zilina city center is a group of climatic sensors placed in 5 different places in the city. To ensure diversity of the data, the sensors were placed in different locations for the example city park, concrete zone, or the highest build-up area in the city. This sensor net collects the temperature and humidity data for 80cm and 200cm height for all sensors. In the article, will be evaluated the influence of the weather on traffic safety in the city.

On **Figure 2** is shown the two used traffic sensor units. The sensor can count traffic for both directions of the roadway, and measure speed and the size of vehicles by the one measuring unit so the works on road and traffic restrictions due to the sensor mounting are reduced to the lowest possible minimum. Only the hole drilling, placing, and backfilling with liquid asphalt resin is necessary for mounting the sensor. [7]

Figure 1 Map of traffic sensors placed in the Zilina city

Figure 2 Picture of used wireless traffic sensors

2. DATA ANALYSIS

The data collecting from traffic sensors started in the July of the year 2021. To this moment the database consists of data from 9 full months of traffic. The data from the summer and also the winter months are available.

Table 1 Road safety index for the week 4.4.2022-10.4.2022 for all 26 measured traffic lines

Place	Total count	Total over limit	Over limit %
Tajovského/Vysokoškolákov.OUT	18747	83	0.443 %
Bratislavská.OUT	7640	111	1.45 %
Tajovského.IN	43079	1255	2.91 %
Kysucká.OUT	14712	438	2.98 %
Bratislavská.IN	14793	731	4.94 %
Košická.OUT.right.lane	11264	602	5.34 %
Rázusa.IN	4684	282	6.02 %
Vysokoškolákov.OUT.right.lane	16637	1083	6.51 %
Tajovského.OUT	27431	1950	7.11 %
Kysucká.IN	9554	834	8.73 %
Rázusa.OUT	14412	1831	12.7 %
Hálkova.OUT.right.lane	35492	4675	13.2 %
1.mája.IN	41396	6005	14.5 %
Štefánika.IN	20854	3569	17.1 %
Komenského.OUT	17635	3557	20.2 %
Hálkova.IN.right.lane	31314	6360	20.3 %
Hálkova.IN.left.lane	34973	7950	22.7 %
Košická.IN.right.lane	7613	1912	25.1 %
1.mája.OUT	34630	9073	26.2 %
Košická.IN.left.lane	18256	4851	26.6 %
Vysokoškolakov.OUT.left.lane	9368	2840	30.3 %
Vysokoškolakov.IN.left.lane	52070	17694	34.0 %
Košická.OUT.left.lane	31438	11228	35.7 %
Vysokoškolakov.IN.right.lane	28214	11296	40.0 %
Komenského.IN	36902	16997	46.1 %
Hálkova.OUT.left.lane	33050	20084	**60.8 %**

From **Table 1** is clear, that the worst case is on the Halkova street and the most speed limit exceedings are on this road. For further and detailed analysis, this road was chosen. This road is the straight connection to the industry area of Zilina and big housing estate areas Hajik, Banova and Zavodie. On the **Figure 3** is shown a pie chart of the vehicles with a speed over 60 km/h for the Halkova street for the output and input direction.

In the **Table 2** are listed the categorization criteria for the length of vehicles and the speed of the vehicles. The length has 4 categories (cars, vans, long vehicles and uncategorized) and the speed has 3 categories (0-30 km/h, 30-60 km/h, >60 km/h). [1,8]

Table 2 Categorisation of length of vehicles (a) and speed of the vehicles (b)

a)

Category	Lenght [m]
0	3 - 7
1	7 – 14
2	14 – 30
3	uncategorized

b)

Category	Speed [km/h]
0	0 – 30
1	30 – 60
2	< 60

3. THE MOST DANGEROUS PLACES DETERMINATION

In the data analysis part were found which roads are driven by the over speed vehicles. It is interesting fact that so many vehicles have a speed over 60 km/h in the strong densely populated zones of the city. It is not available to measure the maximal speed of transiting vehicle in this configuration of sensors since the sensors

have only 3 categories of speed (0 – 30 km/h, 30 – 60 km/h, >60 km/h). For the statement of the most dangerous place data about speeding about 60 km/h from all sensors were compared and then the most dangerous place was researched individually. From the complex analysis of all traffic sensors was found that the place where the speed is most exceeded is Halkova Street. The detail of the place is in **Figure 4**. This road consists of 4 traffic lanes, 2 lines in every direction, it is one of the main road feeders of traffic into the city center. In this place is also strong pedestrian traffic through the pedestrian crossroads which is a very dangerous situation with the combination speed limit exceeding. On the **Figure 3** is shown the composition of categorized vehicles to 3 groups (cars, vans, long vehicles) with speed over 60 km/h and with the percentual ratio of categorized vehicles. [2,3,5]

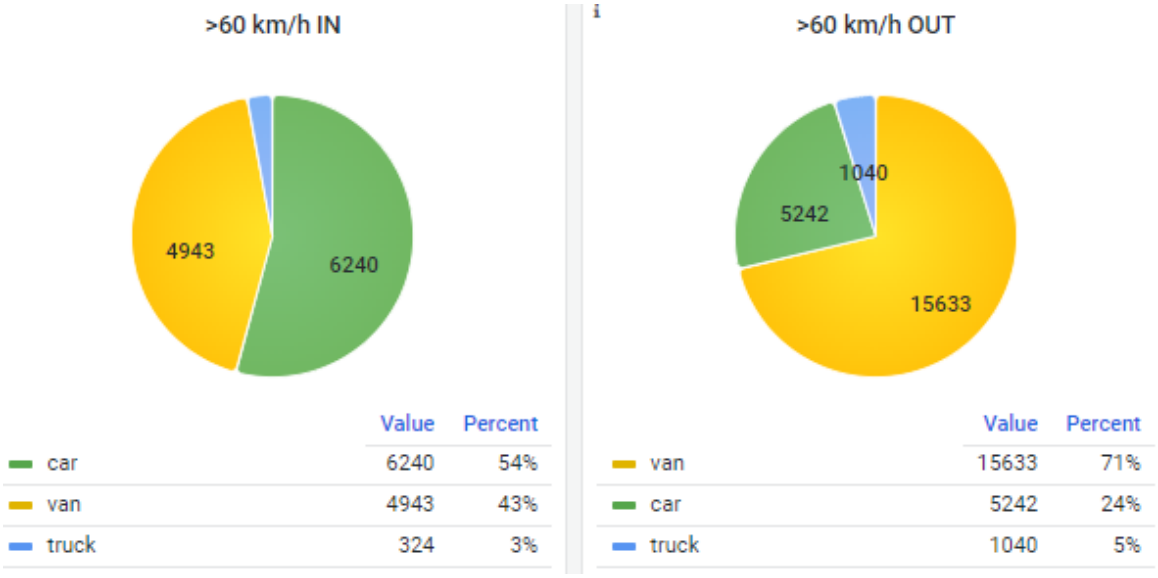

Figure 3 Comparison of vehicles with speed over 60 km/h

On the **Figure 4** is shown the detail of Halkova street with the measurements of distances from the pedestrian crossroad. From the circular crossroad, Rondel is the 110m distance to the pedestrian way and the vehicles have a shorter distance to increase their speed. Another situation is in opposite direction, if the vehicles are on the wax from the city cetre. The distance to increase speed is 270m from another crossroad and this distance is enough to increase speed for cars and vans and exceed the 50 km/h speed limit easily. [10]

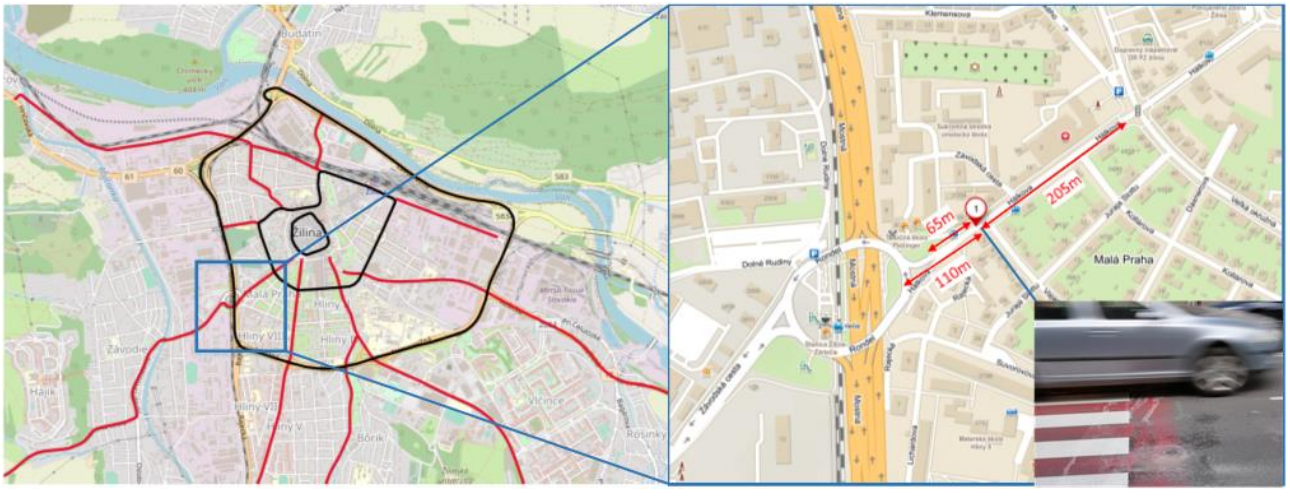

Figure 4 Position of Halkova street on the map and the detail of Halkova street with distances from pedestrian crossroads

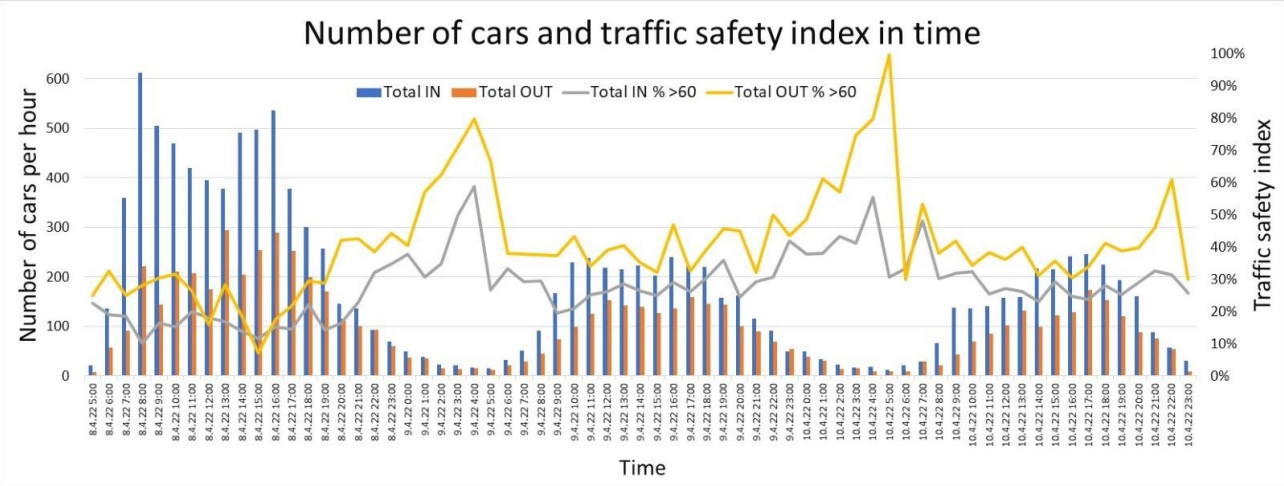

Figure 5 Chart of traffic intensity versus traffic safety index for 8.4. 2022 – 10.4. 2022

The **Figure 5** shows the traffic density and the traffic safety index for Friday to Sunday dates 8.4. 2022 – 10.4. 2022. From the chart is clear that the density of traffic during weekend days is approximately 45 % of the working day traffic. The traffic safety index is a ratio of vehicles over 60 km/h versus the total count of vehicles counted by the sensor. As we can see from the yellow curve, during nights the traffic safety index is significantly higher than during daylight. In some cases, it touches the value of 100%, which means that all vehicles that passed the sensor ran at a speed higher than 60 km/h. since the sensors can sort only speed over 60 km/h and not the exact speed, the real speed of vehicles is not known. In the reality it can be much bigger than the 50 km/h [7,9]

4. CONCLUSION

In this article, the safety on the roads from the view of exceeding the maximally allowed speed limit of Zilina city was described. The database of traffic data from the network of 26 traffic counters was evaluated and the results were graphically presented in the article. Due to the usual exceeding of the speed limit and existing widely used pedestrian roads in the place, the most dangerous place has been determined as the Hálkova street. The next analysis researched that the vans are the major group of speed limit exceeding (approximately 55 % of the speed limit exceeding) is caused by the van drivers. This fact is shattering because vans are types of vehicles with higher overall weight than passenger cars and they are usually used for freight transport. Since the braking distance can be much longer than the braking distance of the car, this group of traffic participant is the most dangerous on Hálkova street. The results from this article about road safety, maximally allowed speed limits exceeding can be a very good suggestion for the traffic police as a determination of the most dangerous place a place with potential of traffic accidents or collisions with non-motorized traffic participants. The random police checks and speed measurements with the combination of other widely used devices to increase road safety road retarders or changeable traffic signs e.g., can increase the road safety for pedestrians or cyclists in dangerous places.

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