



Towards an Understanding of Road Crashes: Taxonomy and Analysis

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March 23, 2022

Towards an understanding of road crashes: Taxonomy and analysis

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Abstract. Every year, around 1.3 million people are deprived of their lives because of the road accidents. Human component grant in the manifestation of 95% of all accidents that are happend in the world. For at least forty years, road accidents in developing countries such as countries of Western Europe and North America are increasing at an alarming rate and have recognized the fact that road accidents are the number one cause of death and injury. This article aims to expose the causes and consequences of road accidents that have emitted different countries around the world and also to see the techniques that have been proposed and applied to reduce the severity of this disaster. This study also fixed a taxonomy on the topic of road crash analyses in multiple areas which presents the factors responsible for accidents and the resulting consequences as well as a table summarizing the articles read where the factors are presented as well as the techniques used.

The interest of this article is to identify the factors of road accidents and consequences of these catastrophic crashes.

Keywords: Crash analysis. Road safety. Crash factors. Machine learning. Taxonomie.

1 Introduction

Road accidents represent a major public health problem, it is therefore of significant importance to understand the factors responsible for these accidents, and the resulting consequences, in order to make decisions in the management of road safety to improve it and reduce the severity of future accidents. Road crashes account for 1.35 million deaths worldwide each year, on average 3,287 deaths a day with an additional 20-50 million are injured or disabled[2][19]

which explains the rate of progression of social and economic problems. The human factor is preponderant and concerns more than 9 out of 10 accidents.

Road crash Prediction Models are very mighty tools that are being used broadly for determining the factors associated with road crashes, and their reasons over a period of time[9].

This article represents some of causes and consequences of road accidents present globally throughout the world and the techniques that have been proposed and applied to reduce their severity.

2 TAXONOMY OF CRITICAL FACTORS AND STATISTICAL INFORMATION OF ARTICLES

This study aims to propose a taxonomy of critical factors on road accidents. Below is a figure that shows the different categories of factors that can influence drivers.

2.1 Driving environment factor

The driving environment factor is associated with different aspects that can influence on the driver's behavior, which causes fatal accidents. Below are the different sections that are discussed.

2.1.1. Speed

Speed is one of the elements that most participate to road mortality, and this is the reason why it is often treated in the field of road safety. People agreed that speeding is a punishable behaviour. It is necessary to educate drivers to respect speed limits, to improve roads infrastructure, to put signs properly, and to use in-vehicle devices to control speeding.

2.1.2. Meteorological factor

Meteorological causes can increase the risk of road accidents, and the patterns are defined as follows: the presence of fog, the lack of visibility caused by a climatic phenomenon, snow, rain, etc (...). Climate change, with increasing variations in air temperature, as well as extreme weather events including heat waves, storms and heavy rainfall occurring more frequently can negatively influence drivers which can produce subsequent fatal accidents.

2.1.3. Pollution factor

Air pollution has also been analyzed as a phenomenon destroying the environment, namely carbon dioxide (CO₂) or tropospheric ozone (O₃)[11] which influence driver behavior, which can cause fatal accidents.

2.2 Habit factor

The factor of driver habits was also analyzed and processed. The following subsections deal with the various aspects of this factor.

2.2.1. Use of mobile phone

Driving and using the mobile phone at the same time multiplies the risk of having a corporeal accident by 4[20]. Drivers using mobile phones are about four times more likely to have an accident. Hand kits do not reduce the risk of having one[20].

2.2.2. Fatigue

Fatigue affects the driver's driving abilities, which would have an impact on the risk of an accident. Fatigue's factor is involved in nearly 10% of fatal accidents[21]. This last can also occur if drivers do not balance driving and working hours, the need for rest and sleep especially if the distance is too far.

2.2.3. Helmet and seat belt

In many low- and middle-income countries, motorcyclists and cyclists account for half of all road injuries and fatalities, head injuries are the leading cause of death, so wearing a helmet correctly in crashes for the driver as well as for the passenger can improve the chances of survival by 40%[20].

2.2.4. Use of alcohol

Alcohol is one of the major risk and a frequent human cause that should never be consumed while driving. Even low levels of consumption are associated with a significant increase in the risk of causing an accident [20]. It presents almost 31% of fatal accidents. Indeed [20], there are other aspects that depend on the factor of habits that can ruin the driver's driving time, namely eating or texting, which can affect concentration on the road.

Attached is a figure showing the critical factors responsible for road accidents, each one attached to its own category.

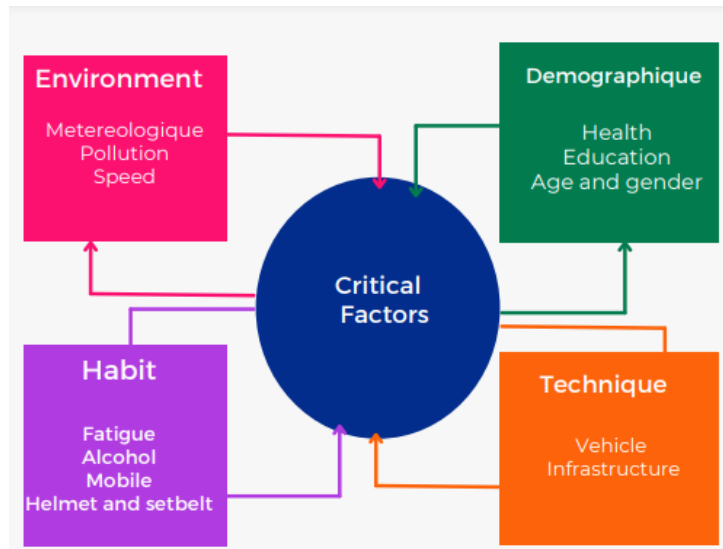


Figure 1: Critical factors

2.3 Technique factor

There is a categorie of a technical factor that increases the risk of road accidents which are composed of two kinds: those relating to the condition of the vehicle and those relating to the condition of the infrastructure.

2.3.1 Condition of the vehicle

The type of vehicle, such as car, bus or truck, etc (...) can potentially influence the behavior of the driver which can cause unexpected accidents. The reason for these accidents can be because of fuel consumption ; a common factor between all these types of vehicles and whose quantity may vary from one to another.

2.3.2 Condition of the infrastructure

Road type was specifically addressed as an important topic in road conditions. Several studies have examined the influence of road type in relation to crashes and concluded that bus drivers are less likely to be responsible for accidents on separate routes[22]. The variances of speed according to different types of vehicles on various types of roads were studied, which revealed that vehicles on the edge lanes had lower speeds than those on the inside lanes.

With regard this category, taking the example of tunnels which can be considered as a factor that may be subject to a higher number of accidents compared to open road sections along the highway. Reflection of sunlight into the tunnel may cause temporary

eye blindness. After entering the tunnel, drivers have to adapt to an unexpected change in lighting conditions, which leads to poor eyesight. At the tunnel exit, unforeseen weather conditions i.e. poor geometrical and environmental conditions must also be taken into consideration[6]. Consequently, accidents caused by tunnels can result in different levels of injury severity, ranging from minor property damage to fatal accidents.

2.4 Demographic factor

The demographic characteristics of the drivers were treated as follows: health ,age, gender and education.. The subsections below detail each of these aspects.

2.4.1. Health

Health plays a very important role in road safety since it is the factor that can positively influence as it can negatively infect the driver's driving behavior, namely stress, fatigue, sleep, which define the frequent aspects of the road's accidents.

Regarding the author demographic characteristics of drivers such as age, gender, education, and also experience which are a very important factors that plays an important role in terms of improving driving style.

2.4.2. Age and gender

There are several specific types of distraction responsible for influencing specific age and gender groups. Teenagers and adults are more prone to being distracted while driving than older adults. Studies have endorsed that younger and older drivers have more fatal crash risks compared to middle-aged drivers[23].Road safety research has also addressed associations between driver gender and increased crash risk. In general, female drivers are protected and secured more than male drivers[24].

2.4.3. Education

According to a study on driver behavior in Lisbon, Portugal, the effectiveness of training and education plays a very important role in reducing adverse events by drivers, such as acceleration and braking abrupt[25].

3 Techniques used

3.1. Machine learning Algorithms

Machine learning is a field of study of artificial intelligence that uses mathematical and statistical approaches to give computers the ability to learn from data, i.e. to improve

their performance, solve tasks without being explicitly programmed. More broadly, it concerns the analysis, optimization, development and implementation of such methods. There is a wide variety of machine learning algorithms. Some of them are used in the articles referenced in this article for labeled data. Regression algorithms, linear or logistic, another popular ML algorithm is the decision tree. For unlabeled data, clustering algorithms are often used. Among the clustering algorithms, we count the K-means which are often used. The table below summarizes the various critical factors on road accidents cited in each article as well as the use of machine learning techniques.

3.2. Statistical information

Statistics is first and foremost a discipline that studies phenomena through data collection, processing, analysis, interpretation of results and presentation in order to make these data understandable and which has been used very often by most of the articles referenced below.

The table below presents a selection of different taxonomies used in this article.

Catégories	Environnement			Demographic			Technique			Habit				Techniques utilisées	
	Speed	Meteorological	Pollution	Health	Age And gender	Education	Vehicle	Infrastructure	Alcohol	Fatigue	Mobile	Helmet and setbelt	Statistic in-formations	Machine learning	
Critical Factors Paper															
[1]				✓									✓		
[2]	✓						✓					✓			✓
[3]					✓				✓				✓		
[4]										✓					✓
[5]	✓				✓					✓					✓
[6]		✓								✓					✓
[7]	✓				✓					✓			✓		
[8]															✓
[9]															✓
[10]															✓
[11]	✓	✓			✓		✓						✓		
[12]	✓	✓	✓				✓								✓
[13]														✓	✓
[14]					✓										✓

Tableau 1: Selected taxonomies

4 Conclusion

Every year, traffic accidents kill around 1.3 million people and around 50 million more are injured[15]. According to the World Health Organization (WHO), road accidents are ranked the ninth most serious cause of death in the world. According to current trends, it could be expected that about two million people will be killed each year in road accidents by 2030. This article has presented the different aspects of the categories of factors responsible for road accidents traffic and a taxonomie of articles which are used a machine learning algorithms to better predict road accident disasters.

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