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Using Visualization Methods in the Investigation Process and Proofing the Course of Traffic Accidents

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Abstract: ***The report deals with problems of role of visualizing information for the investigation process, proving and final legal assessment of crimes. Commonly used visualization elements in the investigation process are stated and possibility of expanding use of this data transfer option is presented not only for the purposes of investigation but also for the needs of expert´s evidence - e.g. the accident course while investigation of traffic accident. The conclusion pointed out the impact of visualization methods not only on investigation and proofing, but also on the final legal assessment.***

Keywords: Visualization, investigation, evidence, Fortis system, video recordings, traffic accident

1. Introduction

The term visualization (English term - visualization, German term - Visualisieren) generally means improving the visibility. Visualization clearly illustrates what we can imagine through visual perception perceived by sight, or through verbal expression. Visualization of information deals with digital processing and presentation of abstract data. The aim of visualization is to process complex data and display it in a visual form that is more demonstrative than numerical or verbal expression for a person. Visualization uses theoretical, technical, software or communication means to highlight defined objects. Visualization is found in many areas of life - construction, engineering, geography, medicine, education, mass media and others, using not only traditional methods, including for example drawing documentation, but modern methods of computer modelling as well.

At present, information recording capabilities, in addition to verbal expression, as well as the capabilities of capturing, storing and transmitting this information are constantly expanding. This is information that describes a particular plot in a given space. The visualization can be targeted to a specific expert set of end users who are experienced with the subject and then analyze the processed data in a visual form. In contrast, visual presentation may be given to a general public as a means of displaying processed data, for example from an artistic point of view. As an example, we can present various presentations from the marketing area, various interactive applications that are utilized and used by general public.

Visualization is a tool that allows you to present a large amount of information and simplifies working with data you process. There is the truth in saying that, "It is better to see once than hear a hundred times".

2. Visual elements in the investigation process

An accurate and clear description of certain information stored in the memory and visually displayed, particularly in connection with criminal investigation and also traffic accidents, where the visualization element of an investigation is usually a video recording of a crime scene, a crime scene photo, 3d scan of a crime scene, crime scene drawing, crime scene sketch map. It is obvious that the activity of investigator must be directed towards obtaining all relevant data and information about the case under investigation.

Visualization represents a type of information that, in its form, can contribute to a significant increase in the verbal value, witness testimony for example. A typical example is examination of a traffic accident witness. At this, the witness can verbally adduce data about asked positions and movements, for example, positioning interaction and movement of vehicles whose interpretation in relation to the place of occurrence of a traffic accident may lead to errors or misinterpretations. In addition, if the investigation is completed, on the basis of an expert's report, it can not be ruled out that the witness will begin to supplement and clarify his original examination on the grounds that the wording in the original statement was misinterpreted or that it was inaccurate.

Therefore, in such cases, a "visualization of testimony" in the form of a sketch which must respect the scale of the crime scene, marking positions of e.g. vehicles at a certain point in time down into the copy of traffic accident sketch map usually leads to an objective and unambiguous assessment of the content of testimony for the purposes of proving and subsequently determining the occurrence and course of such traffic accidents and also prevents any additional contradictions in their proving and legal assessment. It is clear that such a procedure, which is the using of a visualization element - a sketch with marked positions as part of The witness's testimony minutes when it is taking place, can significantly increase the effectiveness and hence reduce the time and costingness of the whole process of investigation, evidence and final legal assessment of a particular crime, for example traffic accident

3. Visualization elements in the process of evidence

These are linked in area of technical evidence of the occurrence and course of traffic accidents, especially for the use of simulation programs, which are equipped for making visual presentations and video recordings from executed calculations, where, as an example, it is possible to mention **PC CRASH** and **Virtual - CRASH**. Aforesaid simulation programs for road accident analysis are able to simulate all possible accident situations. With the help of programs, it is possible to complexly simulate the movement of vehicles from the movement of vehicles, the beginning of the drivers' reactions, the collisions of the vehicles, as well as with pedestrian and subsequent movement to the final positions [1]. This program has been expanded to show a two-dimensional view of a three-dimensional view and uses the display of simulation results in 3D as well as in the form of a video recording from performed calculation [5]. Such output represents a virtual output of evidence and as a virtual element of investigation, it allows to visually depict the space-time course of the accident and will be presented on a specific case.

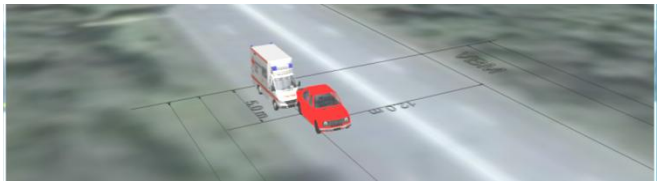
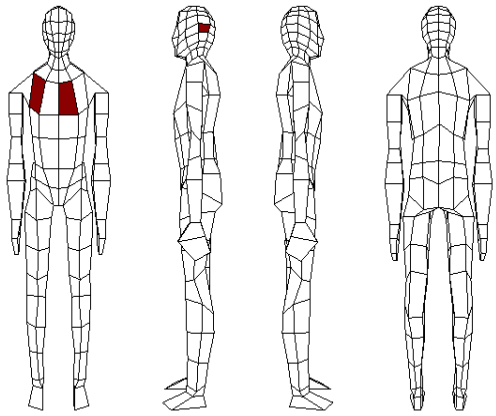


Figure 1: Showing example of 3D output from PC Crash

The visual elements are also used in forensic medicine by the **FORTIS** forensic system designed for parameterisation of injuries and localization of contacts, which assesses injuries and their complications in the effects of mechanical violence [1]. Its use allows a more comprehensive explanation of the severity of the injury and its use in dealing with traffic accidents. Using the FORTIS system, it is possible to provide evidence of the course of an accident even if it is not sufficiently documented (lack of tracks, etc.) from the point of view of normal practice. Aforesaid system is one of the visualization and proofing elements [1]. It is clear that the aforesaid system provides information on the injuries detected beyond the normal verbal medical description of the finding, diagnosis and that these using PC Fortis © not only parameterizes from the point of view of the violence necessary to create the identified injury - health damage but also visualizes the place where this violence on the injured person's body worked. This allows greater use of the forensic medical examination for the purposes of investigation and legal assessment, but also for the needs of technical evidence by using the simulation program, followed by Theory of signatures of injuries and contacts [2].



Meno:

FORTIS

	Celkom	ZPZ	Ko1	Ko2
Trup	6	6	0	0
Panva	0	0	0	0
Pravé stehno	0	0	0	0
Pravé lýtko	0	0	0	0
Pravé chodidlo	0	0	0	0
Lavé stehno	0	0	0	0
Lavé lýtko	0	0	0	0
Lavé chodidlo	0	0	0	0
Lavé nadlaktie	0	0	0	0
Lavé predlaktie	0	0	0	0
Pravé nadlaktie	0	0	0	0
Pravé predlaktie	0	0	0	0
Krk	0	0	0	0
Hlava	0,3	0,3	0	0
Lavé koleno	0	0	0	0
Pravé koleno	0	0	0	0

Celkom: FORTIS ZPZ 6,3
Celkom: FORTIS Ko1 0
Celkom: FORTIS Ko2 0
FORTIS celkom 6,3

Figure 2: Showing output from PC FORTIS - contact points and contact intensity resulting from the severity of the injuries detected

4. Case study of using visualization elements in the process of documenting, investigating and proving a traffic accident

A. Situation:

The present traffic accident occurred at a junction where the public transport bus from the side road did not give priority to the bicycle turning from the main road, while the cyclist dropped down braking in the effort to avert the collision. There was no bicycle and bus collision. After this bus and bicycle left from the place. Upon returning home, the cyclist found that he was injured as a result of fall on the road and the traffic accident in question reported to the police. They carried out an additional sighting of the place of traffic accident. Where they found no usable tracks and a bicycle that was slightly damaged.

Figure 3: Photo documentation of traffic accident site

B. Procedure for investigating and evidence:

Based on the fact that serious damage to health occurred, it was:

Performed forensic medicine evaluation of injuries by FORTIS system by means its parameterization and localization.

Performed amendment of the injured person's testimony to visualize the movement of his bicycle and bus during an accident scene.

Figure 4: Bicycle and bus positioning according to cyclist's testimony - drawing attached to the testimony

B1: Location of TA site and determination of daylight intensity, sun position and the direction of the sunlight made for the purpose of evaluation and exclusion of blinding respectively

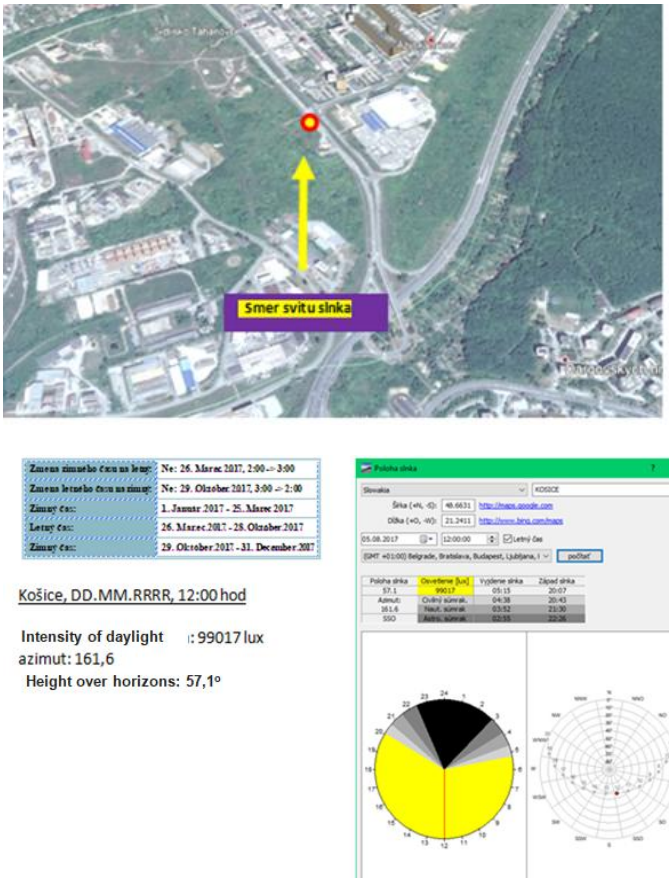


Figure 5: Showing TA location and calculation of light intensity and sun position in PC Crash

Aforesaid performed research led to the conclusion that neither a cyclist nor a bus driver could be dazzled at his sight towards the other participant.

B1: Subsequently, the calculation of the bus and bicycle movement in the PC Crash program was performed using the positions indicated by cyclist (1s, 2s, 3s, 4s)

Figure 6: Movement of the bus and bicycle according to the position indicated by cyclist with their positions in the interval 0,1 s

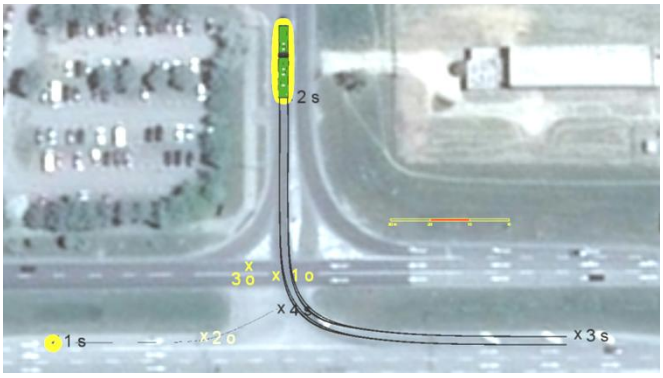


Figure 7: Reciprocal starting positions of the bus and bicycle according to the position indicated by cyclist (in ground plan)

Figure 8: Reciprocal positions of the bus and bicycle at the time the bus was at the junction border, according to the position indicated by cyclist

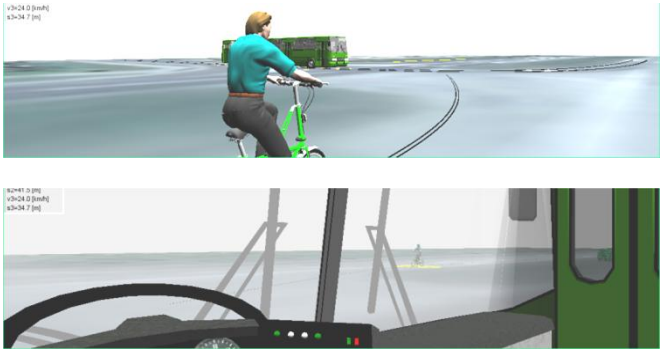


Figure 9: Probable views of cyclist and the bus driver at the time the bus was at the junction border (according to the position indicated by cyclist)

B3: After that, the cause of traffic accident was evaluated according to the position indicated by cyclist (1s, 2s, 3s, 4s) and the performed evidence

Based on the evaluation of the possibility of avoiding the so called indirect collisions and subsequent fall, it was possible for the cyclist performance to report the following serious results:
According to the technically acceptable course of accident, it is possible to assume that the cyclist had the possibility, under the given circumstances, of preventing the occurrence of traffic accident and the occurrence of a collision situation respectively by responding to the bus moving in the junction with the main road, i.e. 2.0s earlier. Mentioned reaction time can be considered as technically justified given the fact that, after the bus has entered junction due to its size, the latter would block the lanes and also the entire juncture during the subsequent stop in front of the collision point and thus giving the priority, which the fact signalized the possibility of occurrence a collision situation, there was a possibility for the cyclist to recognize and anticipate in a timely manner, and with the earlier reaction, it would be enough to slow down the bicycle with a maximum intensity of 25% of intense braking, i.e. safe deceleration to stop without the risk of falling.

5. Conclusion

The aim of the article was to describe and clarify visualization as one of the means of information transfer, its processing and possibilities of subsequent use in the investigation and demonstration of traffic accidents. The importance of visualization and its elements in this process has been emphasized as well as the fact that, if this information transfer method is used appropriately, the process of investigation, proofing and legal assessment of the case can be improved, simplified and accelerated in a significant manner, with the emphasis on the area of traffic accidents, where the content of testimonies and its clear interpretation have a significant impact on the procedure for calculating the movement of vehicles where these do not leave traces and therefore the calculation is carried out with the significant use of statements made by participants. It is obvious, that the described procedure for obtaining and using the relevant information provided in the noticeable way also increases the legal certainty of all the participants because, inter alia, eliminates the possibility of an additional change of testimonies and changes to its content respectively.

As a significant part of the visualization problems, the author also considers the Fortis forensic medicinal system, use of which excludes misinterpretations of verbal forensic findings and verbal diagnoses by technical experts and lawyers who are not professionally competent to carry out injury assessment [3]. By using this system, it is possible to evaluate injuries to the body as criminalistic traces with full tactical and technical value [1].

Based on the aforesaid facts and the presented example, it can be assumed that without using the visualization of the cyclist's testimony it would not be possible to clarify the whole case with sufficient technical and consequently also legal certainty.
The constantly increasing legal awareness of people and the need to increase legal certainty motivates and encourages the further improvement not only that of investigative tactics, but also technologies and methods used, which can ultimately affect not only the effectiveness and quality of investigation and its results but also the legal assessment in the administrative procedure, or legal proceedings.

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