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BLACKBOX - PROJEKT V&V MD ČR

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ABSTRACT

The authors of this paper would like to introduce the results of the National Research Project Ministry of Transport CR called BlackBox.

Project goal is to integrate functions of vehicle's monitoring behaviour pre-crash, during crash and post-crash to the current or developed motor vehicles systems, for the purpose:

- Create an instrument for support to make clear specific road traffic accident (chain accident, etc.);
- Make easier the guilty and innocence clarification;
- Make easier the process of insurance event liquidation;
- Increase the active safety (psychological subconscious of driver about the possibility to documentation behaviour of vehicle);
- Increase the process of legislation to embed system in vehicles;
(e.g. in police, fire brigade vehicles, driver's school);

Participants of the project: Transport Research Centre, e4t electronics for transportation, Brno University of Technology Faculty of Civil Engineering. Project is solved in cooperation with experts of Department of Forensic Engineering, Traffic Police, Insurance Companies etc.

HISTORY

The Black Box units for motor vehicles were firstly planned in early seventies, when the USA Nation Bureau for Road – Traffic Safety started using device, which was able to workout the analog signal and was able to save gained data.

In 1974 were thousand cars equipped by this device. Therefore it covered many groups of drivers. Thanks to this device the analysis of many accidents was possible and it recorded whole process of deceleration of the vehicle, especially Δv . During this year General Motors introduced airbag system in several model lines. There was implemented a special unit whose main characteristic was a data collection and its evaluation whether the airbag should have been activated.

In 1976 GM introduced SDM module (Sensing and Diagnostic Module), which was improved to so called DERM (Diagnostic and Energy Reserve Module) in 1990. The main target of this module consists of recording and saving data from measuring sensors including error messages at the time when the airbag is activated. In 1990 GM installed the first sophisticated electronic accident data recorder in F1 cars.

As it is clear from the article above, firstly the mentioned units were designed as a diagnostic tool for a determination of the reasons for the airbag activation. Later, units were used for accident reconstructions. It was asked by insurance companies and police.

In 1992, thanks to the co-operation of Great Britain, the Netherlands and Belgium the European project called SAMOVAR (Safety Assessment Monitoring on Vehicle with Automatic Recording) came into existence. This project is targeted on motor cars monitoring by black boxes and its possibilities to improve road – traffic safety.

During years, there were more attempts of some alternatives of the black box but it was not widespread used.

CURRENT STATUS

Nowadays, it is not obligatory to use Black box car units in the car in the Czech Republic. This project should make the next step to standardize using of this unit by law. It is possible to image using of these units in cars with higher risk (police, taxi, ambulance etc.).

Association for the advancement of technology (IEEE-SA) started working on P1616 project, concerning implementation of a universal standard of a black box for motor cars. The black box should be called MVEDR - Motor Vehicle Event Data Recorder - and it should work like the same unit in airplanes. This device is being developed for usage in all types of motor cars used in the road transportation. MVEDR project standardizes and defines how the data will be gained, recorded and transferred. The next thing that is mentioned by MVEDR is how these data as date, time, place, speed, number of passengers etc. will be recorded. These data could be used for better development of the passive – safety systems.

Within UNECE (United Nations Economic Commission for Europe), there were proposals from the French expert concerning the standardization study of an events data recorder (EDR)

GRSG group within WP.29 asked for cooperation on the international accident data recorder.

We should think about the topic, why the current units are not used, nowadays. We can see the answer in three main areas: there is no legislative support; units are not implemented to the car; no support for data analysis.

THE BLACK BOX STUDY PROVES ACCIDENT DECREASE

The human behavior is the main factor for the road – traffic safety. Concerning this reason it is very important to motivate people to behave on road more responsible. Following and recording of a driver's behavior could lead to confrontation with the driver's statement, later. It means that drivers, who are aware of this, change their behavior before the accident happen. This should lead to decrease of road accidents.

In 1992, the project SAMOVAR (Safety Assessment Monitoring on Vehicle with Automatic Recording) took place in Europe. Great Britain, the Netherlands and Belgium took part in this project. SAMOVAR project worked also within 'DRIVE 2' project.

It was targeted on cheap electronic systems for recording car data and its communication with other systems and databases. SAMOVAR system included a central interface, which integrated several subsystems used by car or the fleet manager. The complete subsystem included these functions:

- Monitoring and recording of parameters of the car's systems
- The dangerous car, driving or surroundings warning
- Advise driver's position, trip and other information
- Detect and record details about the accident

Within SAMOVAR project the Dutch national road safety research institute (SWOV) made a study No.R-97-8. The main target of this study was to find out whether the road – traffic safeness could be increased by driver's confrontation with objective data and his/her own behavior recorded by telematics device in the car. There were 270 cars with this device included in the study. This devices concerned 'accident reconstruction recorders', 'trip recorders' or 'journey recorders'.

The accident data included in the study were recorded within one year period before and after implementation of the device.

This study showed a big reduction of accidents of different fleets, whose driver's behavior was monitored. The calculated result is that there was 20% decrease of accidents in these fleets.

In SAMOVAR project was monitored 850 cars within one year period. The result was 28% accident decrease and 40% decrease of expenditures spends on repairs. The following table (tab.1) proves this fact. Companies using black boxes are mentioned in this table. (Source Siemens VDO – Automotive)

Table 1.
Decrease of accidents within one year period while fleets use Black box

		Accident decrease	Expenditures decrease
SAMOVAR		-28 %	-40 %
WKD Security		-30 %	-
Vienna police		-18 %-	-40 %
Suedbaden Bus Co.		-18 %-	-59 %
Taxi Hatscher		-66 %-	-
Berlin police		-20 %	-25 %
Border police		-9 %	-34 %
Rotterdam police		-	-25 %
London met. police		-25 %	-

SYSTEM PROPOSAL

Demands on unit

It is possible to divide demands on unit into two categories: technical and economical. Technical part has to provide collecting of relevant data (speed, lights, current position, etc.), its verification and later objective processing. Using of data from the CAN – BUS supplement by other measured parameters is presumed. It is important to reach the lowest expenditures from the economical point of view and to keep the widest spectrum of functions. This philosophy is fulfilled by integrating as much function as possible to current car unit. This solution should reduce duplicate HW features (GPS system, CAN, display...), makes the process of implementation to the car easier and make the same thing during tests and certification.

The recorder that we proposed count on optional implementation to car categories: personal car, lorry car, bus that have CAN – BUS. The implementation to other cars without CAN – BUS is also possible but it needs installation of autonomous sensors. The system takes data from the CAN – BUS periodically. The system analyses data and writes them to the cyclical buffer. When is buffer full, data are re-written. This process is stopped when the accident is detected. This is decided when some specific limits are exceeded. The following criteria were important when we proposed parameters for recording in Black Box unit:

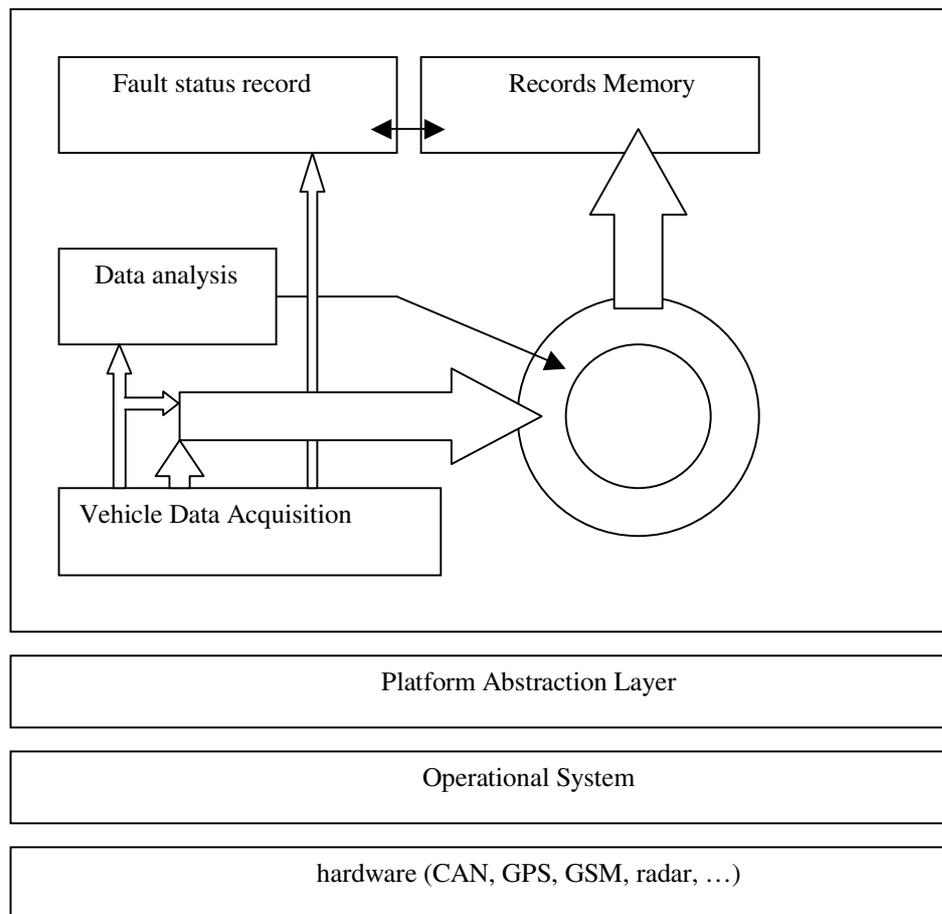
- Information accessible on CAN - BUS
- Architecture of the current car systems with perspective of their further development

- Proposed standards (USA)
- SW compatibility with the current products on the market designated for analysis of recorded data
- Suggestions and recommendations of Škoda Auto developers, experts of Institute of Forensic Engineering, etc.

The proposal supposes a record about the accident in the length of 90s (60s before collision and 30s after collision. It should be possible to record 810 s when the collision is multiphase).

Figure 1.

Internal architecture of the application for data recording



NEW DIRECTIONS IN THE TRAFFIC ACCIDENTS' RESEARCH

There will be possible to find stimulation for analysis and improvement of active safety on the model construction „driver-car-external circumstances“ for both human and technical factor. The active safety has to be understood in context of other features. It depends on each accident's individual conditions and there

are specific questions about reasons and ways how the accident has arisen. For example if there is a stack-up on the highway there are some important questions:

- Was the intention of changing the line advised on time and was the direction light used?
- Were the following cars warned on time by switching on the warning lights?
- Did other cars use any type of warning?
- Is there also reason for accident like driver's fault with following high side acceleration?
- Was the process of the accident influenced by side wind?
- Was the car stability influenced by road defects?
- Was the car's brake potential fully used?
- Were other brake or avoidance maneuvers done?
- How big were distances between vehicles and their speed before accident? What was the time interval between collisions of vehicles?

Providing, that all cars taking part in the accident would content Black box, we could answer these questions exactly, thanks to recorded data.

Black box opens new possibilities and perspectives of the traffic accident research. It concerns results of analysis which provide optimalization of existing safety conceptions in vehicles constructions or new technical features (driving assistant, braking assistant). The substantial thing is that in contrary to tests and controlled driving tests, it is possible to analyze real reactions evoked by subjective feelings, fear and panic. We can gain data not only about behavior of normal driver but also about things diverge from standard.

The driver – dynamic mathematic model was developed in the end of 80's for analyzing drivers' behavior within situation leading to an accident. The combination of these factors should have been analyzing using the model mentioned above. Better description and research of characteristic maneuvers was wrecked because of lack of data and its low quality. Data did not give us enough information about behavior of the driver/car model when danger occurs before collision. Black box unit is able to provide these data in good quality and reliability.