Evidence Collecting Black Box for the Vehicles

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Abstract— Automobile Black Box is a digital data recorder used to record information related to accidents in automobiles. It provides critical data for crash investigation as the Black box in an aircraft provides critical data for air crash investigations. Black box can effectively track the happenings in vehicles during and after the crash. The data from the Black box is accompanied by the inputs given by victims and eye witnesses. Most important requirements for designing evidence collecting automobile Black Box and various design approaches are identified in this survey.

Index Terms— System on Chip (SOC), Smart Phone, Black Box, Closed-Circuit Television (CCTV), Vehicular Ad Hoc Networks (VANET).

I. INTRODUCTION
The number of on road vehicles is increasing every day which is leading to many road accidents. In case of an accident, the passengers are protected by means of various active and passive safety systems that are incorporated into the vehicles. But identification of real cause of an accident is very important for many reasons such as to find out the true culprit, for insurance agencies, for crime cases etc. The true cause of accident can be found if the events that lead to the accident are known. Thus, finding out the cause for the accident is necessary which can be achieved using Black Box.

DaeGeun Lee et. al. [1] describes the concept of car Black box. In vehicle network based car Black box architecture is proposed. SOC design of car black box is described along with the hardware and software design. The design result of proposed car black box system IC [Integrated Chip] is implemented and verified. Dheeraj Pawar et. al. [5] describes architecture of advanced car black box which prevents collision by limiting the speed of vehicle in accident zones. The proposed system sends time and location to the preset number in case of an accident for rescue and treatment. Kangsuk Chae et. al. [10] explains the functionality of the car black box system. An evidence collection car black box is proposed which reduces the privacy concerns, communication and management overheads. The proposed system is implemented and demonstrated under various scenarios. In the demonstration, car black box plays a role of CCTV for preventing crimes.

Maarten Witters et. al. [11] proposes a model for the passenger car black box using dampers. The modeling of passive dampers can be a source of information for the black box semi-active damper model development. The proposed model uses neural network based error model structure. The neural network based error model is represented schematically. The approach is experimented on a passenger car semi-active damper. Eunryung Lee et. al. [12] gives a reliable, robust gateway mechanism and architecture of the car Black box which uses OSEK/VDX. The operating system and gateway application is implemented in C. Thus, the proposed gateway system operates efficiently and is reusable. P. Ajay Kumar Reddy et. al. [13] designs a prototype for car Black box which can be installed in any vehicle. The prototype uses very less number of circuits. Hardware and Software resources required for the prototype and the necessary block diagrams are provided. Detailed description of each of the resources is also given. The prototype is implemented and experimented and the results of the experiments are also provided. Abdallah Kassem et. al. [14] proposes a prototype model for car Black box by describing the hardware and software resources required in detail. Hardware resources include speed sensors, switches, brake sensors, microcontroller, data transmission module etc. Software is developed using Visual Basic.Net programming which is user friendly for the end user.

Liewei Jiang et. al. [2] introduces a car Black box system. A functional requirement analysis of car Black box along with its primary demands is made. A new design is proposed for car Black box and its hardware, software design is
The proposed system offers advantages such as large capacity, long-term storage, collecting, processing and storing of multiple signals at the same time. Chulhwa Hong et al. [3] proposes usage of VANET [Vehicular Ad Hoc Networks] for developing a car Black box system. Few assumptions are made for the proposed system. Smart phone is used in the system to acquire information from the car Black box. Security features such as access control and data integrity are offered by the system. Lilia Filipova-Neumann et al. [4] tries to reduce adverse selection in automobile insurance by proposing a car Black box. Personal identification and more detailed monitoring of behavior of driver are included in the proposed system which is helpful for insurance companies in case of an accident. The author provides a possibility for the insuree to choose between conventional contracts without black box and contracts with black box which provides minimum access to insurer.

Chetan Patil et al. [8] explains the car Black Box and its features such as accident detection, automatic accident notification, CAN compatibility, cost effectiveness, etc. The top level design of car black box is presented with the primary functions such as Event Data Recorder and Automatic Accident Detection and Notification. Ahmad Asi et al. [16] discusses a system level design representation for a black box system which serves the functional needs of a Transportation Vehicle. A Black box design is proposed which includes both vehicle data recorder and also a voice and visual recorder so that an incident can be accurately reconstructed from vehicles status and visual recordings. The design allows analysts to determine whether incident was vehicle error, operating error or environmental factors. A. Alesandri et al. [19] proposes the dynamic models to describe the traffic on a freeway which are based on information about density, speed and flow. This information can be provided by a wireless cellular network without using expensive data acquiring devices. The problem is addressed using Black box approach, without fluid assumption about macroscopic model and it uses a neural network to identify freeway traffic dynamics.

A. B. M. Rezbaul Islam et al. [6] uses the data in the car Black box for timely maintenance of the car and for rescue at emergency times. Maintenance and Rescue subsystems in the proposed system are described in detail along with the architecture and algorithms. Mooseop Kim et al. [7] proposes a method to secure the Black box system against data modification and data forgery. Thus, a secure memory structure design is used for car Black box to secure data storing process. An efficient verification method is also included in the system. The proposed system is implemented using commercial black box. Willie D. Jones [9] discusses about the Black box feature in the automobile that leads in solving the accident cases of over speeding in a street where speed limit is fixed. Paper discusses about IEEE 1616 standard which helps in creating the baseline for information like velocity, engine revolutions per minute, throttle position, use of brakes or seat belts. The author insists that the customers unwilling to install Black box will face insurance claims problems.

Jiri Plihal et al. [15] introduces the results of National Research Project Ministry of Transport CR called Black Box. Project goal is to integrate functions of vehicle’s monitoring behavior pre-crash, during crash and post-crash to current or developed motor vehicles systems. Roland R et al. [17] discusses the efforts to safeguard mobility and fight against with an annual fatality rate of more road deaths. Explain the advantages of eventual fitting of Black boxes to record parameters that are useful in explaining the cause of the accidents in road vehicles. The paper discusses the case of impact by definition is un-normal one.

Esa-Estec [18] develops Black box system for the vehicles. The Black Box system stores position information and in vehicle data. It supports wireless communication for data exchange with the black box and allows third party services and it is tamper proof. G. Cambourakis et al. [20] creates digital system which is capable of controlling several functions in a modern car. Most important driving parameters are stored in memory, protected from shocks, moisture and high temperatures. These driving parameters can be used for after crash investigations.

II. CONCLUSION

It can be concluded from this survey that there is an essential need of Black Box in a vehicle for after crash investigations. Black Box can obtain the data such as monitoring the driver behavior, vehicle position and other related vehicle parameters necessary for the crash analysis for the insurance agencies, crime cases etc. The various approaches to design the Black Box and its necessity for vehicle crash investigations are covered in this survey.
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