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Research Article

CBOX: A Vehicle Data Recorder

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Abstract

As the transportation mechanism in our current world is complex, a problem related to crash investigation is exhaustive. The most common mode of transportation is basically road and also the common area of crashes. A post-crash investigation is always an area of less expertise. In order to enhance the investigation and for awareness towards a better safe use of road we can use a prototype of vehicle data recorder. The device captures vial information in active state. The data is kept encrypted within the embedded memory after a crash which can be used for detailed investigation, thus contributing in investigation and road safety.

Keywords- *Aircraft Blackbox, Dashcamera, Wired Crash Detection System*

1. Introduction

The rate of vehicle accidents or road transport accidents (Dinesh Mohan *et al*, 2015) is always high nowadays due to increased traffic and unhealthy driving habits. So if there is a device which could provide the exact reason and those parameters which led to the accident then without further procedures and investigations the result could be processed voluntarily.

Using this kind of devices could be used to provide awareness among the public and also the feeling of being monitored helps to reduce accidents considerably to a very low rate.

In current situation many countries use dash cam and police departments of many countries use video capturing techniques from dashboard to record chasing sequence and law breaking actions.

If there is a hit and run case the possibility to find the culprits are very less and require tough investigation. Car accidents investigations start by rewinding the most appropriate possibilities that led to this accident (Dinesh Mohan *et al*, 2015). But it takes a huge amount of time and also gathering of proof and causes are very difficult and more time consuming.

The proposed device could provide complete information that led to the accidents. The data like video surveillance, speed, temperature, fire under hood are some of the data that are recorded by the device providing proof for the accident. So unwanted road blocks, quarrels, insurance enquiry can be minimized to a very great extent, saving victims faster and clarity for the cause of accident is assured.

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A. Dashboard Camera

Various types of dashcam are available on the market, ranging from basic video cameras to ones which also record parameters such as date/time, speed, G-forces and location. Most dashcams are manufactured in Asian countries such as China and Taiwan. Due to the lack of governmental regulation in those countries, there is usually very little quality control in most dashcams.

Dashcams are widespread in Russia as a guard against police corruption and insurance fraud, where they provide additional evidence. They have been called ubiquitous and an on-line obsession, and are so prevalent that dashcam footage was the most common footage of the 2013 Chelyabinsk meteor, which was documented from a dozen angles. Thousands of videos showing automobile and 5 aircraft crashes, close calls, and attempts at insurance fraud have been uploaded to social interactive and sharing websites such as YouTube, Facebook, Twitter and other websites. Dashcams are gaining in popularity in many parts of Asia, Europe (particularly in France), Australia and the US.

In Switzerland, their use is strongly discouraged in public space as they may contravene data protection principles. In Germany, while small cameras for personal use in vehicles are allowed, posting footage from them on social-media sites is considered a violation of privacy and thus forbidden. Dashcam footage is only in exceptional cases admissible as evidence in a German court. In Australia and Poland, recording on public roadways is allowed as long as the recording does not infringe upon one's personal privacy in a way that may be deemed inappropriate in a court of law. Drawbacks of dash cam are following

- User can fully interfere in the system.
- Used to record interior of vehicle also.
- No standardized measures.
- No monitoring system or issuing body.
- Lawfully banned in some country

B. Aircraft Blackboxes

Any type of aircraft in any condition of flight can be viewed in terms of its input parameters (e.g. control instructions) and output parameters (e.g. flight sensors), without any knowledge of its internal workings, as a flight black box model (Ankan Ashish *et al,* 2012). The flight data recorder (FDR) is a device that preserves the recent history of the flight through the recording of dozens of parameters collected several times per second. The cockpit voice recorder (CVR) preserves the recent history of the sounds in the cockpit including the conversation of the pilots. The two recorders give an accurate testimony, narrating the aircraft's flight history, to assist in any later investigation. The FDR and CVR may be combined in a single unit. The two recorders are required by international regulation, overseen by the International Civil Aviation Organization, to be capable of surviving the conditions likely to be encountered in a severe aircraft accident. For this reason, they are typically specified to withstand an impact of 3400 g and temperatures of over 1,000 C (1,830 F) as required by EUROCAE ED-112. They have been required in commercial aircraft in the US since 1967.

- All information are stored.
- Carry heavy device and highly complex circuits.

2. Architecture

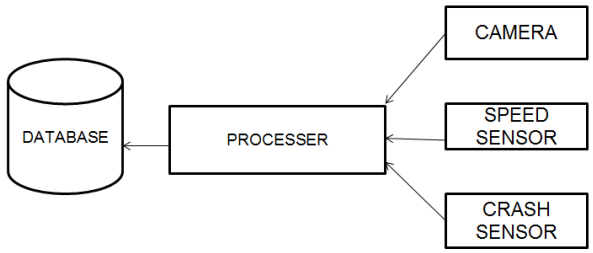

Fig.1 Basic Architecture

Fig 1 shows the basic architecture of sensor and devices. Device functions as long as the car is running. Device contains front and back camera which records the video and speed reading from speedometer using sensor connected to speedometer voltage fluctuations (as per initial phase). Crash sensors fixed at 4 points around the car frame or (b)-trying to minimize the number of crash sensors by using a single sensor connected by metallic string (placed in more precise points around car body-including D pillar) which initiates a signal to board if tremor is observed within the metallic string(when crashes). When signal is received by the board it then stores the data permanently in storage medium. The data in device is refreshed every 10 minutes (to minimize the storage issue and hence the cost issue too) if no crash occurs until o stage (complete journey) and so on. When an accident has occurred then following is done.

A. Working

- Crash sensors detect a crash and signal is propagated to board in order to permanently store the last obtained data as follows (every 4 side is covered in crash sensing zone using sensor).
- If the accident has occurred at time T then the video of every event is available from last refresh point to time T where (t-T) less than 10 minutes.
- The speed variation within the time range t0-T is also stored.
- Device will be equipped with illuminating red LED within it to point out the device in dark or in crashed situation.
- Post-crash scenarios
- Police and investigators can check the data in device removable or transferable (usb) memory storage unit.
- Manner of accident can be learned perfectly from the video data from front
- and back camera, speed readings during the event.
- Can summarize whose fault it was whether the equipped car or the other car by checking the video and speed of equipped car.
- Signal is provided in the driver console to show whether the device used in the car is working or damaged
- Data in device must be made accessible only by authorized personnel.
- Users must not be allowed to tamper the data in device.
- Device main board will be placed in very low impact zone in a vehicle.

B. Video Surveillance

Front and back cameras ensure video recording for a fixed time which provides the external video surveillance showing the possible external factors that lead to accidents and driving demeanor of the drivers proving whether reckless or calm.

C. Time

Live clock is provided, hence the time sequence of every post-crash event can be understood easily. Monitoring time information helps to find the time value at the moment of crash.

D. Speed

The speed of car equipped with vehicle data recording system is recorded until the point of crash. The speed

data is essential as to know which vehicle was over speeding as this data will be important in investigation.

E. Temperature

The temperature helps in finding whether any overheating issues is a reason for the malfunction of electrical units and crash.

F. Pressure

The pressure sensor will be placed in a bladder like compartment which has the ability to withstand pressure variation for a range. This sensor in turn provides one of the signals stating the vehicle has crashed.

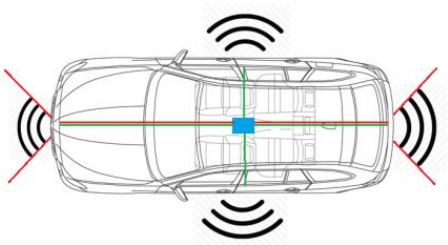

Fig.2 Sensors and Device position

G. Hardware Implementation

- BMP 180 pressure and temperature sensor

BMP 180 is a Bosch made pressure sensor which basically measure the barometric pressure and temperature. In C Box we enclose BMP 180 in a expandable bladder which gives a spike in pressure during even the low impact contacts.

Most sensors tend to communicate with other devices based on one of three well-defined mechanisms: I2C, SPI or good old analog output. There are dozens of other serial buses and communication protocols out there (CAN, 1-Wire, etc.), and they all have their strengths and weaknesses, but I2C, SPI and analog cover the overwhelming majority of sensors you're likely to hook up to your development board. I2C is a particularly useful bus with the for two main reasons that is it only requires two shared lines: SCL for the clock signal, and SDA for the bi-direction data. transfers. Each I2C device uses a unique 7-bit address, meaning you can have more than 120 unique I2C devices sharing the bus, and you can freely communicate with them one at a time on an as-needed basis. It uses 3.3V power in and GND of apart from SCL and SDA of raspberry pi.

- HC SR501 object detection system

The HC SR501 is a basic PIR sensor which uses the heat radiating from body to detect movement and gives corresponding signal whether an obstacle is present or not. It uses the 5V in and a GPIO pin with GND.

- Camera

A very usual webcam is used as the camera for video surveillance. The camera is connected to the board. The pixel rate of the camera is a large factor in processing time.

- **Wired Crash detection system**

The wired crash detection system is a self-made simple electro-mechanical device that can detect body frame based impact and send a corresponding signal to the raspberry pi board (http://www.raspberrypi.org/ resources/ learn).

- **Speed monitoring**

The speed of the car is monitored by connecting a wire that is bypassed from the speedometer cable which supports the new drive shaft based speed sensor. The pulse is amplified and driven to the board.

F. Software Implementation

Integrate data from various sensors to each frame of the video. It includes Pressure and Temperature values from BMP 180, Human presence from Motion Sensor, Date and Time from Operating System, Chassis Number of the Vehicle.

Detect crash according to Pressure value.

If Bladder Pressure > Crash Threshold pressure , crash is detected and a crash Routine is invoked , else erase the video and restart execution.

Define Crash Routine.

- Encrypt the Video file which contains all the information.
- Transfer the encrypted file to Removable Storage.
- Implement the client side of device Analytical App.
- Decrypt the File in the Removable Storage.
- Copy the Decrypted File to Local Server.
- Designing of UI to view the content.
- Restricting access to UI by user Authentication.
- Device is extended with an Android app,
- The functionalities include
- Continuous querying for crash using Accelerometer Sensor. b) If Shake > Crash Threshold send Current location to Specified Mobile Number.

3. Future Work

The development was done in different step. The basic step is to build with camera and speed sensor. Later the following features are planned to be added and currently is working on such topics.

- Cloud based centralised data storage.
- Longer surveillance period.
- Centralised Monitoring
- IoT based system.

Conclusion

Due to rising number of accidents and traffic based fatalities this is expected to have a huge impact in the traffic technology. Once the public come to know about the exact proof of such accidents due to reckless and rough manner of driving they could improve and bring much change in the manner of traffic commutation.

When the culprits start thinking about any kind of false idea of crime using transportation system, they can be foiled by such a device.

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