VEHICULAR BLACK BOX

Varun Srivastava[1], Srijan Mandal[2], R. Jayaraj[3]

[1]*Student, Information Technology, SRM University, Tamil Nadu, India*
[2]*Student, Information Technology, SRM University, Tamil Nadu, India*
[3]*Assistant Professor, Information Technology, SRM University, Tamil Nadu, India*

ABSTRACT

Abstract: This paper presents the concept of Vehicular Black Box by utilizing a Raspberry Pi (or any other mini-pc) for processing data collected by various sensors and modules to sense and calculate various metrics of a vehicle. The various metrics can potentially help reconstruct situations such as collisions/accidents leading to possibly quick resolution of vehicular accident cases. The Vehicular Black Box may contain modules like a hall-effect sensor, which senses change in magnetic field to calculate the speed of the vehicle. A crash collision sensor can senses impacts. A video camera module can record the vehicles journey from the driver's point of view. These could prove influential in resolving cases and insurance claims.

Keyword: -*Black Box, Raspberry Pi, hall-effect sensor, camera module and collision sensor.*

1. INTRODUCTION

India is among the top nations in terms of number of vehicle plying in the country. This number also keeps increasing at an alarming rates especially in urban and semi-urban areas. This signifies the increase in purchasing parity of the people. This unfortunately also has in turn has a number of adverse effects. One being that the number of vehicular accidents have also steeply increased. This is credited to poor training of drivers and complacency. The current executive administrative construct is incapable of solving road accident related cases. This is due to lack of rods under surveillance and the difficulty in collecting the real evidence relating to such cases. The project aims to tackle these issues by allowing all vehicle owners to own the device at a minimal cost (relative to current market options) and the characteristic of being modular in nature.

Most commercial implementations are either expensive or come integrated to the vehicle at time of purchase. This prevents it from being feasible to most vehicle owners. This project attempts to bring the ability to install the Vehicular Black Box onto any motor vehicle. The device would also be modular in nature, meaning that the peripherals can be upgraded in the future as well as newer modules could be added or removed based on choice. The basic data collected will not be available wirelessly, or over the internet but will be stored locally on a memory card. This is to prevent any high jacking of the data. On impact the video clip is permanently saved on the memory card. It can store variable (metrics) such as vehicle's speed, seat belt status, etc. All of the mentioned data will be time stamped to improve the ease of reconstructing, forensically, the impact or accident.

Devices and products with the black box like features have been available for quite a few years now, but they happen to be very expensive and are not modular in nature. The project improves on previous attempts at similar concept by bring modularity and the options to add, change or upgrade the peripherals and modules. This is important as it provides a choice in the modules and peripherals based on needs. This is one reason why the device would be more affordable than current options. Another utility of the device will be to provide quickly accessible evidence in the form of the collected by the sensors. This will potentially help in speeding up car accident related cases such as crash litigation, insurance settlements.

2. HARDWARE

2.1 Raspberry Pi 2

The project currently utilizes a Raspberry Pi 2 "Model B" to cater to the need of processing the data and acting as a control system. Here is the full list of specs for Raspberry Pi 2 Model B:

- SoC: Broadcom BCM2836 (CPU, GPU, DSP, SDRAM)
- CPU: 900 MHz quad-core ARM Cortex A7 (ARMv7 instruction set)
- GPU: Broadcom Video Core IV @ 250 MHz
- More GPU info: OpenGL ES 2.0 (24 GFLOPS); 1080p30 MPEG-2 and VC-1 decoder (with license); 1080p30 h.264/MPEG-4 AVC high-profile decoder and encoder
- Memory: 1 GB (shared with GPU)
- USB ports: 4
- Video input: 15-pin MIPI camera interface (CSI) connector
- Video outputs: HDMI, composite video (PAL and NTSC) via 3.5 mm jack
- Audio input: I²S
- Audio outputs: Analog via 3.5 mm jack; digital via HDMI and I²S
- Storage: MicroSD
- Network: 10/100Mbps Ethernet
- Peripherals: 17 GPIO plus specific functions, and HAT ID bus
- Power rating: 800 mA (4.0 W)
- Power source: 5 V via MicroUSB or GPIO header
- Size: 85.60mm × 56.5mm
- Weight: 45g (1.6 oz)

All the collected data is curated and saved locally onto a micro SD-Card. In case of an accident or any other incident the memory storage device may be extracted for the purpose of analysis and forensic reconstruction of the incident.

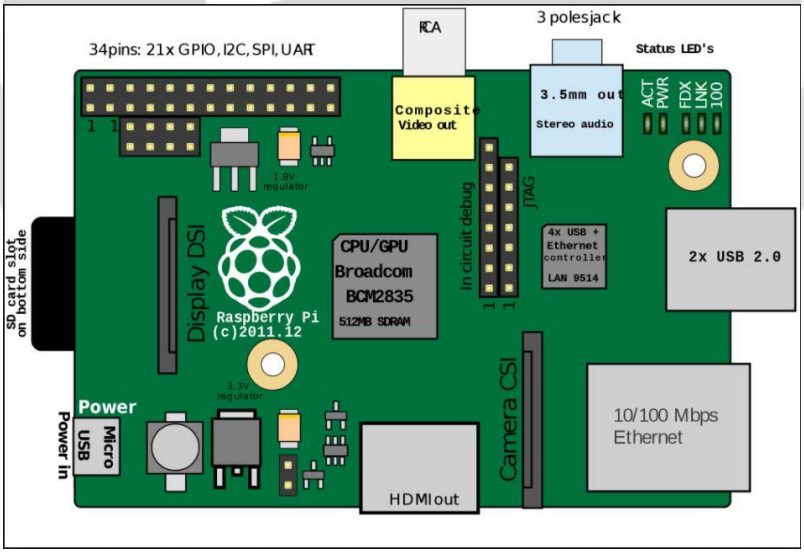

Fig -1: Raspberry Pi 2 Model B

2.2 Video Recorder

The Raspberry Pi Camera Module v2 has a Sony IMX219 8 MPimage sensor (in comparison the previous generation was equipped with the 5-megapixel Omni Vision OV5647). This camera module has been repurposed

tocapture video footage from the vehicle (from the driver's point of view) and could in the future be programmed to capture stills photographs in this project. It is a fairly simple module which is ready to use, out of the box and can be implemented with simple plug and play. The recoding of the video footage happens continuously and the decision to store the video data (time stamped) permanently to the memory storage device is done dynamically. If an impact (collision) is sensed the video is permanently saved to the micro SD Card, covering footage from a 30 minutes (or any other designated time frame) prior to the collision. It is capable of recording videos at 720p60 and VGA90 video modes. Thismodule is compatiblewith the Raspberry Pi 1, 2, and 3. The module hardware can be accessed through an MMAL and V4L APIs.There also exist a number of third-party libraries built to support it, including the Pi camera Python library.

2.3Impact Sensor

The impact sensor is a pressure sensitive module, which sends a signal to Pi, which can give an appropriate response (to save video footage from the Camera V2 module). If collision happens upfront of where collision module is installed, module outputs low level signal; no collision, outputs high level signal.Module reserves M3 mounting hole, convenient for fixation on a car.

The Description:

- Module size: Approx. 3.7*2*0.9cm / 1.46*0.79*0.35inch
- With switch indicator light, if there is collision, light is on; no collision, light is out.
- Material: FR4 Epoxy Glass Fiber

Pin definition:

- +Pin: 3v-12v power supply
- -Pin: GND
- S pin: Gigh-low level signal output

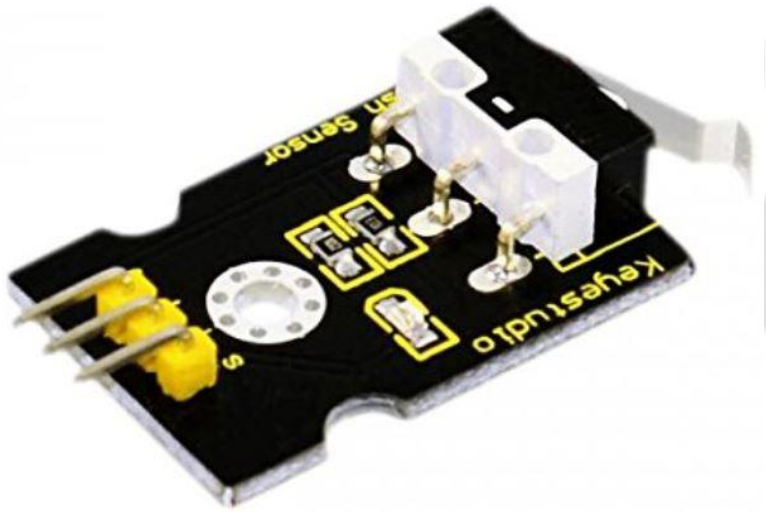

Fig -2: Impact Sensor

3. SYSTEM DESIGN

The device functions as long as the vehicle is in the running state. Device contains the camera module which records the video and speed reading from speedometer using sensors which are connected to the speedometer voltage fluctuations (as per initial phase). Impact sensors fixed at the microcontroller board frame which initiates a signal to the board if impact is observed within the microcontroller board (when crash has been detected). When signal is received by the board it then stores the data in the storage medium which is also placed along with the entire setup. The data in device is refreshed every 10-15 minutes (in order to minimize the storage issue and therefore the cost matrix also) if no crash occurs until the final stage (complete journey) and so on.

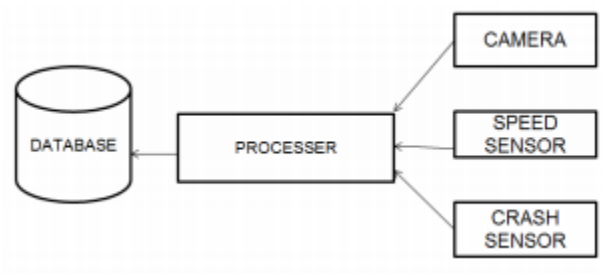

Fig -3: Block Diagram

When an accident will occur, the impact generated in the body of the vehicle will trigger the impact sensor. When impact sensor gets triggered, it will automatically cut off the power supply from the battery and also begin the recording data from all the sensors installed on the microcontroller board. Then it will store all the numeric data inside the memory slot. When the investigation teams suppose the insurance companies wants to retrieve the data from memory unit, they will have to connect complete system with the PC or another equivalent supported system. After that they will have to use the retrieve data option from the setup, which will retrieve all of the data stored and video recordings and display it on the screen of the PC in the numeric as well as graphical format.

4. CONCLUSIONS

Due to increase in number of road accidents and traffic system based fatalities all around the globe, this system is expected to have an effective influence in the traffic technology, in speedy judgments, in the field of road safety as well as ease the process of insurance claim settlements because of the accurate data retrieved. Once the product is out to the public, the exact proof of any road accidents due to reckless and rough manner of driving could improve and bring much change in the road safety of traffic commutation. Also in case of some culprits who start thinking about any idea of crime using the transportation system, they can be tracked and foiled by such a device.

5. ACKNOWLEDGEMENT

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6. REFERENCES

[1]. http://www.raspberrypi.org/resources/learn
[2]. http://www.adafruit.com/category/32