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Study and Literature Survey for Evidence Collection System for Car

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Abstract: The collection of the real time data after the detection of collision around the vehicle environment and analyze the collected data to have the conclusion regarding the collision and simultaneously transmitting the data over the wireless network. The Evidence Collection System is vehicle based device which is use to collect the data like speed, engine temperature, Brake status, LPG sensor, Alcohol content, acceleration, GPS position, wiper movement, and time etc. This data can be used to investigate the crime, rescue operation and insurance claims. This data then transmitted to the database server so that web application can be able to access this information at different places like police station, Insurance Company. In this paper, I am going to investigate the use of evidence collection system by using different sensors and wireless communication.

Index Terms: Evidence Collection System, Car Black Box, Xbee module, Sensors.

I. INTRODUCTION

The vehicle accident is a major public problem in many countries, particularly India. Despite awareness campaign, this problem is still increasing due to rider's poor behaviors such as speed driving, drunk driving, riding without sufficient sleep, etc. The numbers of death and disability are very high because of late assistance to people who got the accident. These cause huge social and economic burdens to people involved. Therefore, several research group and major motorcycle manufacturers have developed safety devices to protect riders from accidental injuries. However, good safety device for vehicles is difficult to implement and very expensive. On the roadway driver usually keep a safety distance from one another. On the other hand, due to the driver's interruption, long-time driving tiredness, or a sudden break applied by another car, a serious collision may occur.

Even though the driver is in a conscious mind, he cannot respond immediately to control his/her vehicle. Sometimes crash may occurs due to bad weather situations as mist, vapor, fog and so on. Like Black Box of airplane, Car Black Box (known as Event Data Recorder) is used to record information related to accidents. Car black box records driving data, visual data, collision data and position data before and after the accidents so that it can be used to analyze the accident easily and to settle many disputes related to car accident such as crash litigation, insurance settlements. It can be used to not only reconstruct what happened before an accident by Insurance agents and police but improve vehicle design, roadway design and emergency medical service by automakers, government and hospital. In addition to the basic function, the car black box equipped with wireless communication system can send accident location information to central emergency and disaster server in real-time. Therefore drivers who want help can receive service quickly by rack car, police and hospital ambulance. Car Black Box detects a crash automatically, and also records the motion of the vehicle and driver's actions during a predefined time period before and after the accident. It consists of data collection devices for collecting the information about car's status and the driver's actions, a nonvolatile memory device for recording, a microprocessor for controlling the unit and a wireless modem for communication.

The main objective of the proposed work is: developing a prototype of Black Box For vehicle diagnosis that can be installed into any vehicle. This prototype can be designed with minimum number of circuits. This can contribute to construct safer vehicles, improving the treatment for crash victims, helping insurance companies with their vehicle crash investigations, and enhancing road status in order to decrease the death rate.The collection of the real time data after the detection of collision in an around the vehicle environment and analyze the collected data to have the conclusion regarding the collision while simultaneously transmitting the data over the wireless network.

II. LITERATURE REVIEW

In this paper, author uses a prototype of Black Box For vehicle diagnosis that can be installed into any vehicle. This prototype can be designed with minimum number of circuits. This can contribute to construct safer vehicles, improving the treatment for crash victims, helping insurance companies with their vehicle crash investigations, and enhancing road status in order to decrease the death rate.[8] This paper presents a low cost system which provides solution to the existing automotive control issues. This system has two main principle components namely Vehicle to Vehicle Collision Avoidance Unit (VVCAU) is used to avoid crashing

between vehicles and Black Box (BB) records the relevant details about a vehicle such as Engine Temperature, Distance from obstacle, Speed of vehicle, Brake status, CO2 Content, Alcohol content, Accident Direction, trip Time and Date. The design selects ARM 7 (LPC 2148) as embedded controller, UART (Universal Asynchronous Receiver Transmitter) is the common peripheral found on microcontrollers widely used for communication with the external devices and systems, I2C (Inter-Integrated Circuit) for on-board communication, Real Time Clock, Electrically Erasable Programmable Read Only Memory and GSM module.[9]

In this paper, a new framework for conducting controlled driving behavior studies based on multiuser networked 3-D virtual environments. We report on the results of our study from two viewpoints: 1) the reproducibility of the traffic accident situation (i.e., state variables of interest are recreated successfully in 78% of the cases); and 2) the interactive car-following behavior of human subjects embedded in the traffic situation of the virtual environment. [1] In this paper, a process to collect critical video clips from car black boxes using smart phones. Critical video clips in the black box are hashed to provide data integrity before being transmitted to the police server. Without VANET infrastructure, smart phones are very useful communication media for car black boxes.[2]

In this paper, the composition and function of an advanced controller system of Car Black Box. The system can not only record the main driving data of the car comprehensively and accurately in real-time, but also reconstruct the accident with data process software, which can help people analyze the accident rapidly and legitimately after a collision. A review of recent researches on Car Black Box is first presented in this paper. The author then analyzes the main problems and development direction of Car Black Box and put forward the necessity of developing Car Black Box with high performance. The author also proposes an integrated design solution for Car Black Box. The design selects the Samsung's S3C2410, which includes CAN controller, pulse counter module, A/D convert module and GPIO interface, audio-out, RS232 interface and USB port. The Car Black Box can receive real-time data including driving speed, rev, light, car door, tire pressure, brake, lay-up and life belt, and also process the data and store it in RAM. Based on the experiment, it is proved that the designed hardware circuit can work accurately and reliably.[3]

In this paper, how to effectively collect and manage information obtained from car black boxes in vehicular networks. The car black box is a vehicle-based CCTV which records video images, sound, GPS position, speed, and time. These data can be used for accurate car accident investigation and some public crimes prevention. However, there are important issues such as user privacy and a data management for a vehicle-based CCTV records. The proposed evidence collection system can reduce driver privacy concerns and communication and management overheads.[4] In this paper, Embedded controller for Car Black Box using SoC (System on Chip) technique. System on Chip (SoC) is the effective method to implement embedded system like car black box, which consists of processor, memory, I/O peripheral and several interfaces. SoC for Car Black Box system consists of 8051 processor, CAN (Controller Area Network) controller, JPEG compressor, SD controller for dumping the data from memory buffer to SD card, ROM for programming and SRAM acting as memory buffer. Describing the design process in the hardware and software, it was shown in the verification using MFC(Microsoft Foundation Class) program whether the required data such as image, location and other vehicle control status information was recorded and recovered.[5]. In this paper, vehicle safety system which would not only record the video and audio, but also try to prevent a possible collision by limiting the speed of the vehicle in accident-prone areas. In case of an accident, the time and location (co-ordinates) is sent through GSM to a preset number for immediate rescue and treatment. Recorded data can also be used for forensics, revealing the problems that caused the accident and give manufacturer an idea for improvement. So the motto is to develop an embedded integrated system consisting of a microcontroller, a power supply unit, sensors, memory, a motor driver unit and a GPS/GSM modem.[7]

III. METHODOLOGY

Stage 1: Real time Data collection

In first case the data is coming to the input port of the controller which will continuously get the data. When the collision is detected by collision sensor the incoming data to the input port of the controller will be saved to the memory device connected to the system while transmitter connected to the output port of the controller will simultaneously transmit the data to the wireless network.

1) Visual data: The Visual information in front and rear side during driving from camera is taken.

2) Driving data: Driving information such as speed, brake and seat belt status, steering performance is taken.

3) Collision data: Time, speed and shock power when accident occurs is taken from accelerometer.

4) Positioning data: The car positions checked in real time by GPS. These data are saved temporarily in RAM as memory buffer and transfer to the Flash
memory like SD card.

Stage 2: Report Generation

In this case, at receiving end the collected data after the collision will be received by the antenna. The received is decrypted and the fed to the server machine so as to store the data to the database. Then the web application developed can be deployed on web server which will use this collected information to generate the reports. The conclusion can be generated logically which can be made available on internet with very less time which can be further use by accident investigation, insurance claim and hospitals for handling emergency situations. Analyze the accident easily and to handle many problems related to car accident like crash litigation, insurance settlements etc.

Stage 3: Wireless communication

The proto type can be designed to get the actual output. The data can be collected using the different sensors

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connected. The Web application can be designed on .NET platform which use the SQL server database for database management. The web application can be locally published on the IIS (Internet Information Service) to test the generated reports. Transmitting the all data via Wireless Network, such as CDMA and GSM/GPRS when accident to main control center. Support rapid service for rescue and treatment of accident. Here we are going to use XBee module. The car black box contains not only a record of what was happening in the last seconds before the impact of accident but also the record after a collision. So it should take the most recent data values and store them in buffer with a circular sequence (RAM). When the black box senses the accident, buffer refreshing is suspended and the data before and after accident are transfer to flash memory automatically.

IV. HARDWARE COMPONENTS AND DESIGN

A) Block diagram

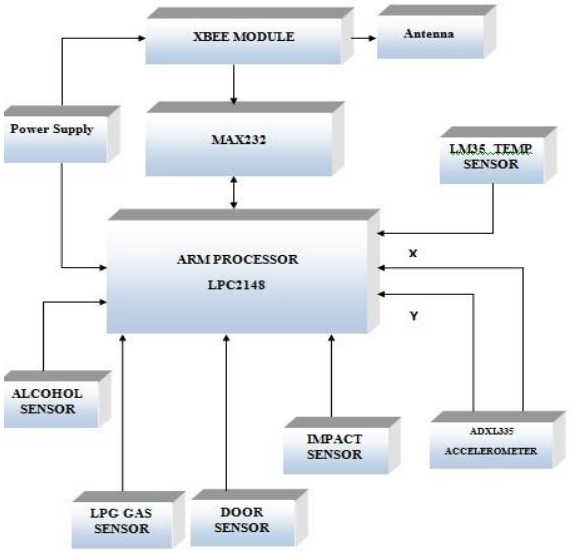

Fig.1.Block diagram of Transmitter side

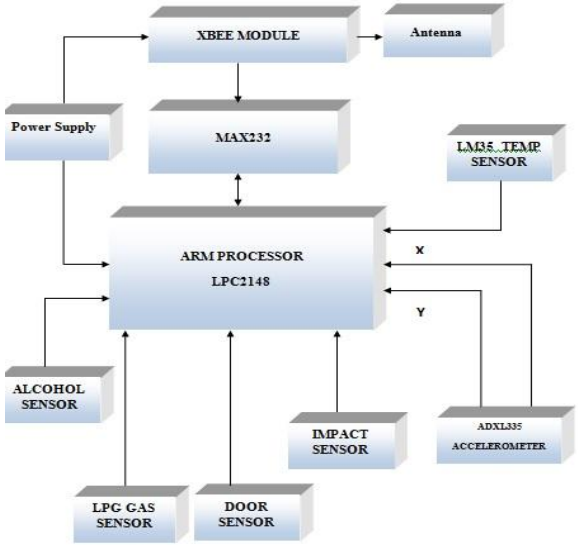

Fig.2. Block diagram of Receiver side

B) Block Diagram Description

i) ARM7 TDMI PROCESSOR

The system uses ARM 7 (LPC 2148) microcontroller as a master controller.

Features:

- 32-bit ARM7 TDMI-S microcontroller in a tiny
- LQFP64 package,
- 40kB of on-chip Static RAM,
- 512kB of On-chip Flash Program Memory.

One or two 10-bit ADCs provide a total of 6/14 analog inputs, with conversion times as low as 2.44 µs per channel, Single 10-bit DAC provides variable analog output. Multiple serial interfaces including two UARTs (Universal Asynchronous Receiver and Transmitter), Two Fast I2C-bus (400 Kbit/s), SPI (Serial Peripheral Interfaces) with buffering and variable data length capabilities. In-System Programming/In-Application Programming (ISP/IAP) via on-chip boot loader Software, Single flash sector or full chip erase in 400ms and programming of 256 bytes in 1 ms.

- Two 32-bit timers/external event counters (with four capture and four compare channels each), PWM unit (six outputs) and watchdog, Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.

ii) Temperature Sensor

Engine temperature is important in engine control unit, if this value goes to abnormal, some unwanted gases exhaust from vehicles due to improper combustion. In this project, in order to obtain the vehicle engine temperature, we have used LM35 temperature sensor. This temperature sensor continuously reads the engine temperature and fed to the microcontroller. The output of LM35 is given to LPC2148. It converts temperature value into electrical signals. Its temperature sensing range is -55 to +150°C.

iii) Alcohol Sensor

In this, MQ-2 gas sensor is used for alcohol detection. It is high sensitive to alcohol, simple drive circuit, stable and long life. If driver has drunk, then alcohol sensor sends signal to microcontroller. The output of MQ-2 is given to LPC2148 and message is displayed on LCD.

iv) LPG Sensor

In this, MQ-6 gas sensor is used for LPG detection. It is high sensitive to LPG. If the level of LPG is more, MQ-6 LPG gas sensor sends signal to microcontroller. The output of MQ-6 is to LPC2148.

V) Accelerometer sensor

The ADXL335 is a small, thin, low power, complete 3-axis accelerometer with signal conditioned voltage

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outputs. The product measures acceleration with a minimum full-scale range of ±3 g. It can measure the static acceleration of gravity in tilt-sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration.

vi) Impact sensor

In this, piezoelectric type of sensor is used as impact sensor. When piezoelectric device (PZT) detects a mechanical impact, it emits signal which is given microcontroller. It is used to detect mechanical shock or vibration in its vicinity.

vii) Door status sensor

In this, limit switch is used for door status. A limit switch is electromechanically device that consists of actuator mechanically linked to set of contact with actuator, device operates the contacts make or break electrical connection.

viii) GPS

The Global Positioning System was conceived in 1960 under the auspices of the U.S. Air Force, but in 1974 the other branches of the U.S. military joined the effort. The first satellites were launched into space in 1978. The System was declared fully operational in April 1995.The Global Positioning System consists of 24 satellites, that circle the globe once every 12 hours, to provide worldwide position, time and velocity information.

GPS makes it possible to precisely identify locations on the earth by measuring distance from the satellites. GPS allows you to record or create locations from places on the earth and help you navigate to and from those places. Originally the System was designed only for military applications and it wasn't until the 1980's that it was made available for civilian use also.

ix) XBee-

XBee is the brand name from Digi International for a family of form factor compatible radio modules. The first XBee radios were introduced under the Max Stream brand in 2005 and were based on the 802.15.4-2003 standard designed for point-to-point and star communications at over-the-air baud rates of 250 kbit/s.Two models were initially introduced—a lower cost 1 mW XBee and the higher power 100 mW XBee-PRO.]

Since the initial introduction, a number of new XBee radios have been introduced and all XBees are now marketed and sold under the Digi brand. The XBee radios can all be sed with the minimum number of connections – power (3.3 V), ground, data in and data out (UART), with other recommended lines being Reset and Sleep.] Additionally, most XBee families some other flow control, I/O, A/D and indicator lines built in. A version of the XBees called the programmable XBee has an additional onboard processor user's code. The programmable XBee new surface mount (SMT) version of XBee radios both introduced in 2010.

C) Circuit diagram

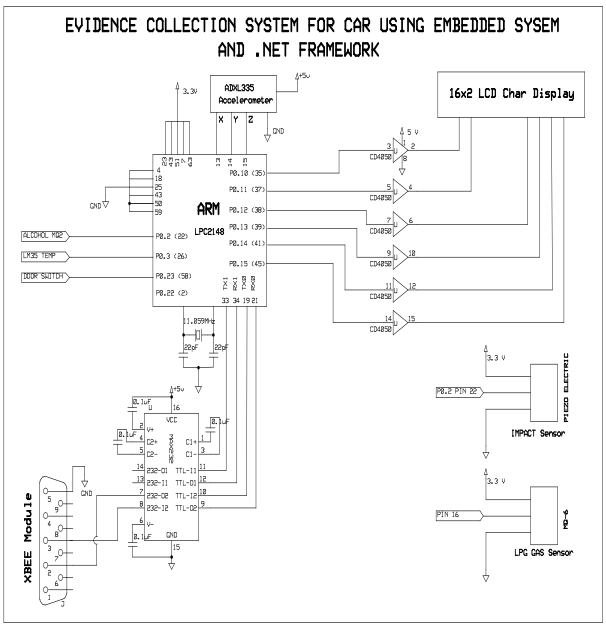

Fig .3 Circuit diagram

V. CONCLUSION

In this, I have used ARM7 controller to receive and transmit the collected evidences data over wireless network by using Xbee transmission which indeed is collected at police database server using ARM 7controller and receiver. The collected parameters are vehicle id, seatbelt status, speed, engine temperature and steering angle respectively from the prototype designed. The collected data by controller not only transmitted to the server but also is saved to the memory at transmitting end, which in case of wireless transmission failure will be helpful for extraction of data. Web application developed will gives an flexibility to watch the generated reports to the person/institution who has authority for that like Police, Insurance Company etc.

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