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# Design and Implementation of Black Box for Security and Monitoring of Automobile

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**ABSTRACT: In a country with the third largest road network in the world, the total number of vehicles in India stood at 230 million out of which 60 percent are the personal vehicles. With increase in vehicles, the driving experience and safety of the commuters have become a major area of interest. Black Box are very common devices when it comes to aircraft but now, with growing atomization & traffic accidents these devices could also be used in automobile sector. The black box is a device which records all the information of a vehicle like speed, engine temperature, tire pressure, acceleration, headlight intensity, location, etc. All this data need to be stored but if the storage is on board the danger of losing it on accident was very prominent, so the data was stored on cloud by using Firebase. The other problem was placement and range of sensors as the device should work on terrains, like mountains or desserts, the sensors used must be able to withstand the various conditions it suffers. The other feature includes maintenance reminders and alerts provided for certain conditions. Maintenance reminders are used to alert the user about the vehicle servicing status, it then can be used to enhance or justify the resell value. Alerts are for parents/vehicle owners with transport corporation where the user will alert if the vehicle crosses certain limit.**

**Keywords:** Low cost Black box, Servicing alerts, Global Positioning System(GPS), Monitoring, Accident Analysis, Automobile tracking

**Abbreviations:** EDR, Event Data Recorder; LDR, Light Dependent Resistor; GPS, Global Positioning System; GSM, Global System for Mobile communication ; EEPROM, Electrically erasable programmable read-only memory;

## I. INTRODUCTION

Road traffic crashes rank as the 9th leading cause of death. According to the 2019 statistics, deaths due to road crashes are about 1.25 million a year which means approximately 3287 in a day [1]. Therefore it was necessary to understand the graveness of this issue and serious actions need to be taken.

Currently Event Data Recorders are used by some manufacturers in India but their data is unusable for general public and is just utilized for design improvements. Also these do not have any standards or regulations to be followed. In other countries like, USA, with the upcoming auto drive options in electric cars, there are strict regulations regarding these EDR. Similarly Japan, Korea, Switzerland and China have formed such laws [2, 3, 4]. But in India such laws are never brought up or even discussed by the authorities. A recent Bharat New Vehicle Safety Assessment Program in 2017 has made manufacturers to comply with the safety parameter performances. It ensures seatbelt reminders, airbags, etc. but it didn't even mention EDRs.

Now, the problem with EDR was that in large vehicles it is only triggered with electronically sensed faults in system and data was stored internally on EEPROM which was continuously rewritten with a memory for about 5 minutes of records before a collision. We resolved this by using cloud storage. This helps the data to be stored and utilized for something meaningful like maintenance reminders. We also targeted to reduce the cost and hence noted and divided causes of accidents into various factors [5] as shown in Fig. 1.

From that we tried and removed the factors that were not in user's hand or could have been counted as non-essential for the device. By this we were able to maintain the cost effectiveness of the device. So that it is not too heavy on the pockets.

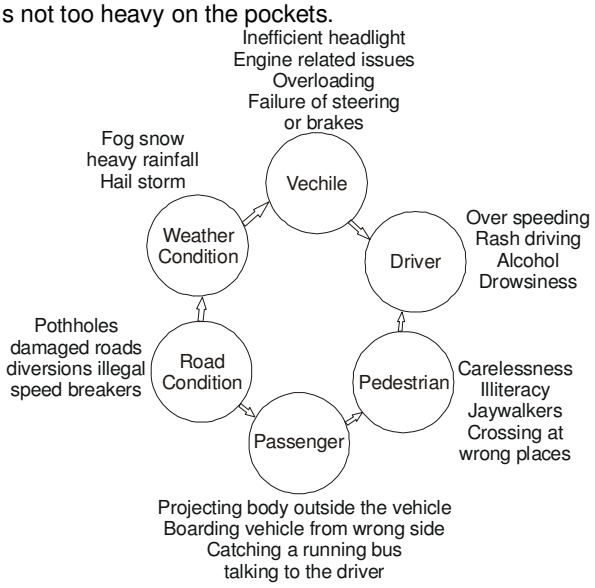


**Fig. 1.** Factors contributing to road accidents.

The proposed model focuses on a black box system for low budget automobile, hence it tried to figure out a way to record and monitor [6, 7, 8] the important factors and create a simple circuitry which could be installed in almost all the cars, without increasing its cost to a great extent. Therefore, finally this paper aims at establishing a system which in turn could be made mandatory for new as well as existing automobile in the country. This would help the people for regular monitoring of the automobile as well as the upgrades for maintenance required.

The proposed model could also be used as a tool or proof against the claims of insurance settlement [9] and help in investigating and analysis of an accident for police and authority work [10, 11]. The other features will include clients for speeding beyond a set speed or overloading vehicle beyond certain weight limit. Also reminders for servicing related problem, thereby keeping a check and ensuring smooth functioning of vehicle.

## II. PROPOSED MODEL

The primary focus of this proposed model was to evolve and uplift the existing road safety measures in India. The paper focuses on creating a black box which could capture and record the significant vitals only, thus removing the unnecessary overheads, hence reducing the cost. With a drastic increase in population and no other means of transportation that is popular. We knew we had to find some solution to deal with the increasing accidents.

The block diagram (shown in Fig. 2) of the proposed model gives the insight of the features and functionalities of what this model is trying to achieve. The first part of the proposed model consist of sensors which is the interface between the hardware and software part. It is responsible for gathering the raw data, which could further be processed and then converted into information, which would be accessible according to our needs.

The aim of the proposed model is to be as adaptive as possible, so that the industries could mold it according to the needs of the government as well as the customers. We are planning on using the Arduino Uno as the Signal Conditioner since it reduces the complexity of the circuitry. The next stage consist of the micro controller which here is Raspberry Pi.

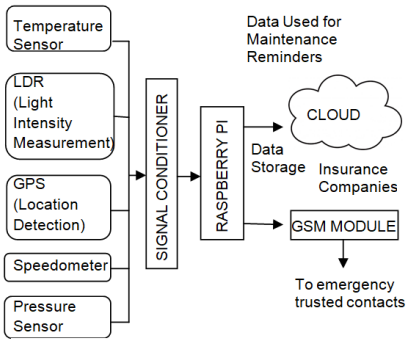


**Fig. 2.** Block Diagram.

And the final stage consist of the cloud as well as the GSM. The cloud is our database, which could help the government bodies, industries, etc. Insurance companies could extract data from this database and then remittances could be provided after proper surveying. Apart from this, this data is also used to send reminders about servicing to the customers. This is done by using the data collected from the sensors and then matching it with some preset threshold values. The information collected would not hamper the privacy of the customers and will be accessible only after proper orders. We also used GSM for emergency cases, where we can provide information about the vehicle to selected contacts.

## III. METHODOLOGY

This part focuses on the flow of data, which is finally converted into useful information. The flowchart in Fig. 3 represents the graphical flow of the information.

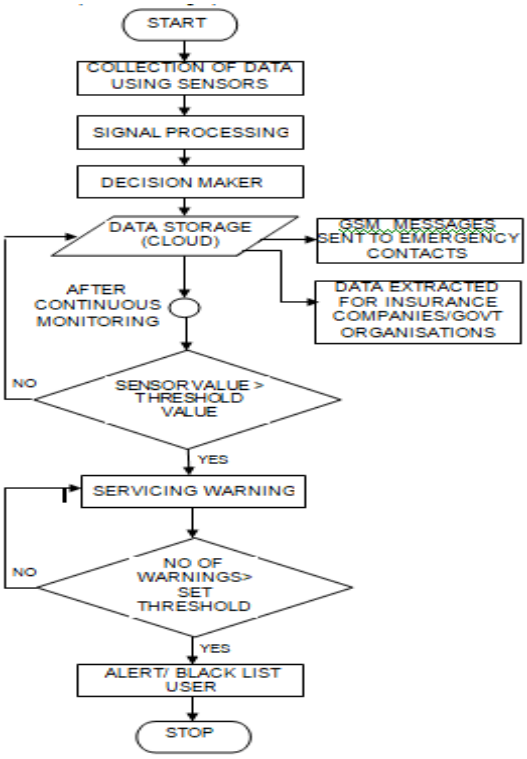


**Fig. 3.** Flowchart.

Here as discussed earlier we start with the collection of raw data from sensors, which is in analog form. The signal conditioning block if the microprocessor converts these Analog signals to digital and is stored in the RAM of the microprocessor. The next step is to upload the data over to cloud. From these it could be extracted by the government bodies or other agencies. Also after this we aim at building a system that provides regular reminders and check about servicing by analyzing the data collected.

Now after having a glance at the processes taking place in this model, we turned our attention to the major functionalities we targeted to aim.

The proposed model focus on four major functionalities, which are displayed in Fig. 4. The process starts with collecting the input from the various sensors, with the help of Arduino IDE. Here functions are used like

setup(), loop(), etc. The setup() function initializes the various parameters required like the pinMode, analogs pins, digital pins, etc. Whereas the loop() function is used to continuously monitor the values through the various sensors which are further communicated to the Raspberry Pi.

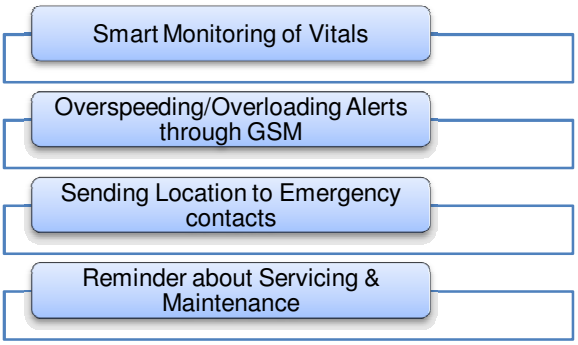


**Fig. 4.** Major Functionalities.

To achieve the above mentioned functionalities the model is divided into smaller modules.

*A. Sensing Module*

Sensing module consists of sensors like LDR, temperature sensor, GPS, etc. This module is our eyes and ears. It detects all the changes in the various parameters which are being monitored. This module needs to be carefully calibrated before use and properly placed to get accurate values. The number of sensors can be increased to increase the accuracy but the complexity increases as well. These sensors collect values from the attached device like the headlights, rear lights, engine, etc. The data collected from the sensors are then passed through a signal conditioning block and then interfaced with the controller.

*B. Main Module*

The main module consists of the micro controller. It is the central processing and controlling block of the system. It serves as the brain of our model. It is responsible for gathering data from all the sensors in raw form, converting it into digital form, processing it and collecting it in a single location to further upload it into cloud module. It also has to make decisions based on inputs like detection of accidents, sending of location and alerts to emergency contacts and managing the over speeding and overloading alerts.

*C. Application/Cloud Module*

This module comprises of the data which has been stored in the cloud or the internal storage. Once the data is available it becomes very easy to use it for various purposes like alerts for servicing, data for insurance settlement, etc.

## IV. EXPERIMENTATION

The project started with taking the input from various sensors like LDR, LM35 (Temperature Sensor), GPS, etc. Then the next step was to check these output and then process them according to what we proposed. If the output the specified sensors like LDR, Temperature exceeds a specific value the warning would be provided. Because this might be because of the malfunction of head lights or by the raise in temperature of engine, which could be highly undesirable.

Now the output of the various sensors are fed to the micro controller and then it will be fed to the cloud or the local storage for data storage. This data could be used for various purposes including insurance settlement, police security, etc. Also at the same time data also goes to the trusted users by GSM. The simulation results are showed in Fig. 5.

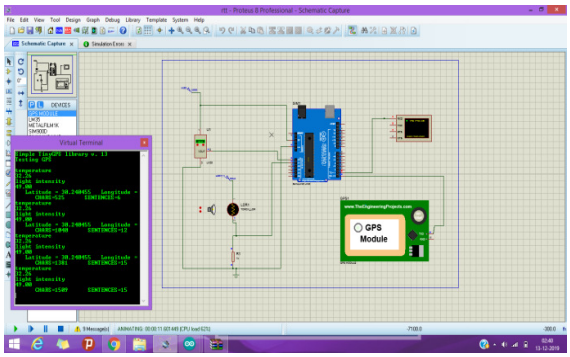


**Fig. 5.** Simulation.

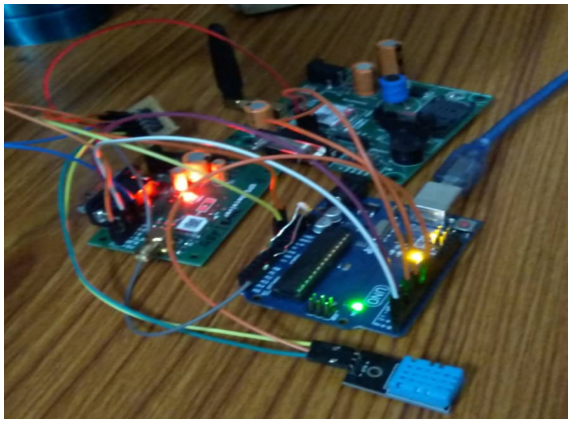

**Fig. 6.** Hardware.

## V. CONCLUSION

Rash driving, over speeding, overloading and ill mannered vehicles are few of the major causes of accidents in today's world. And the number of deaths and injuries it causes is alarming. Therefore it was necessary to try to come up with something which is simple, efficient and useful.

The Black Box for automobile already exist in many parts of the world. But in this paper we attempted to create a model which would suit the Indian Market where there is a shortage of such accessories and devices for automobile. The proposed model aimed at creating a module which could be easily included in current vehicle and installed in upcoming or later vehicles without much modification hence not adding up a lot to the cost of the automobile immensely.

The objective was set to achieve a detailed analysis of the causes of road accident and deaths caused by it, and then try to remove each one of the problem one by one, in the most economical and effective way possible. Hence the proposed model also serves as an effort to improve the current status of the roads of the country.

Our aim during the course of this model was to remove the costly overheads increasing functionality and creating a model with the bare minimum components which could perform the required functionality without any exceptions.

## VI. FUTURE SCOPE

Apart from its current use of insurance settlement, accidental investigation and analysis. There is an immense area of possibilities for expansion of the proposed model.

If such devices are declared mandatory or all vehicles have such devices preinstalled, then tracking a vehicle's location, having record of its usage could be made available to the user and authorities. This reduces issues regarding stealing of vehicles, getting traffic updates, tracking private vehicles on rent like Zoomcar, etc. This could also be achieved by just giving unique numbers to the black box.

Now another important advantage could be, services provided by the government vehicles like bus, ambulance, etc can also be monitored and hence initiatives can be taken for its improvement which means depending upon the traffic congestion actions are taken like increasing the number of buses of a particular route or the number of ambulance in an area.

With the increasing focus on Sustainable Development Goals, and a deadline to achieve them by 2030. We could use such a model to monitor the vehicle emission, also at the same time we can discard old vehicles if proper maintenance is not done because they would cause serious environmental issues.

Also awareness of people will increase since they are being monitored. This could either be willing or just to not get into any trouble since their actions are being recorded.


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**Conflict of Interest.** Authors declare no conflict of interest.


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