Passenger Safety from Oxygen Defficiency and Fire Accident by Automated Mechanism in Automobiles

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ABSTRACT

From the history of vehicle accidents, it is found that fire and toxic gases (except collision) are the main contributors in loss of human lives. Smart vehicles, though equipped with sensors for detecting oxygen deficiency, toxic gas leakage and fire, they do not feature any mechanism for automated safety of the passengers. This paper proposes an interlock mechanism that detects abnormal environment condition and activates electromechanical actuators to stop the vehicle, release the seat belt, wind the window panels, and to open the door of vehicle to aid the passengers escape from the impending mishap.

Keyword: Vehicle accidents, automated mechanism sensors, smart vehicles, automated safety mechanism, interlock mechanism

1. INTRODUCTION

This paper describes an automated safety system for passengers during oxygen deficiency and fire accident in a vehicle. According to US statistics, it has been found that an average of 550 people per year have died and nearly 3300 people have been injured per year due to toxic gas and fire accidents in vehicle.

Smart vehicles like BMW, Mercedes Benz, and Honda etc though equipped with sensors like fire detection sensor, toxic gas sensor, they are designed to merely give an alarm. However, such announcements alone will not be of much use, because in such emergency cases, the following scenarios might arise.

- Passengers have their consciousness but in fear they could not make a right decision.
- Passengers lose their consciousness and they could not escape from the vehicle.
- Passengers have their consciousness but due to failure of mechanisms they could not escape from the vehicle.
- Passengers may not be aware of inhaling the toxic gases inside the vehicle cabin, which leads to suffocation and may result in a slow poison of the victim.

Incorporation of an automated mechanism, to perform the following tasks as per the situation, can solve the problem.

- Vehicle stops and will not move further
- Automatic releasing of seat belt
- Automatic window winding mechanism
- Automatic door opening mechanism

This can be achieved by the integration of automotive principles with electronics, using Microcontroller.

2. DESCRIPTION OF THE SYSTEM

In this system, vide Fig. 1, a fire sensor and toxic gas sensor are employed to inform the microcontroller in case any abnormality by generating logic level signals. The microcontroller polls the respective ports to read the assertion levels and initiates appropriate sequence of actions as summarized in Fig. 2.

Case 1: Fire accident

In case of fire, for instance, the desired sequence of operations is to stop the vehicle, release the seat belt and...
open the doors to facilitate the passengers to escape. This is achieved by the microcontroller and the electromechanical actuators placed in situ.

The vehicle is stopped by cutting-off the electric or fuel supply which can be achieved by an electronic switch or a solenoid assembly. When this happens with the gears engaged, the vehicle, due to its inertial motion, tends to drive the engine and as a result of torque balance, the vehicle stops shortly. The seat belt is released by means of a solenoid and a plunger mechanism. An electric motor and its electronic drive circuitry can be activated by the microcontroller to open the door.

**Case 2: Oxygen deficiency/leakage of toxic gas inside the vehicle**

In this case, the microcontroller actuates the relay and electric motor to wind the window panels to open, so that the atmospheric air enters the vehicle cabin thereby making the passengers to breathe normally with sufficient oxygen.

### 3. COMPONENTS OF THE SYSTEM

**Direct-Current Motor**: Direct-Current motors are used in some special applications where high starting torque or where smooth acceleration over a broad speed range is required.

In this proposed vehicle, two separate DC shunt motors can be used such as
- 12 volt DC shunt motor for automating the window winding mechanism.
- 12 volt DC shunt motor for automating the door opening mechanism.

**Microcontroller**: The microcontroller to be used in this proposed vehicle will control all the peripherals of automated safety. The microchip to be used is PIC16F870. Peripheral Interface Controller with 16 bit Flash memory is the abbreviation for PIC 16 F870. The main purpose of using PIC 16F 870 is that it has inbuilt analog to digital conversion.

**Sensor**: A sensor is a device that converts energy from one form to another, preferably, electrical. In this proposed design, fire and toxic gas sensors will be used to detect their presence.

**Fire Sensor**: Fire sensor comprises of a smoke detecting portion for detecting smoke which changes in response to a smoke density, an external temperature detecting portion for detecting external temperature and a temperature difference calculating portion for calculating temperature difference. A correction factor deciding portion decides the correction factor for smoke signal based on the temperature difference by multiplying the smoke signal by the correction factor.

**Toxic Gas Sensor**: The toxic gas sensor is fixed in the cabin to detect the toxic gases such as carbon monoxide and oxides of nitrogen that might leak into cabin from the exhaust gas.

**Relay**: A relay is an electromechanical device made up of an electromagnet and a set of contacts. This relay functions similar to that of a wired remote control switch. The current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts thereby making NC or NO.

**Optocoupler**: It is used to provide electrical isolation and driving capacity for driving the relay.

### 4. CONCLUSION

A bird’s eye view of the design has been presented in this paper. However, numerous factors, like ergonomics, economics and fail-safe principle, play significant role in the design and implementation of the propounded safety mechanism in an automobile. The electrical and mechanical devices/components must fit without demanding much modification in the existing automobile. In a proving ground, fire accidents and toxic gas leakages are highly probable and providing such an automated-safety enhanced system can render more confidence to the participants of the trials.

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