AUTOMATIC CAR WINDOW OPENING USING MECHATRONIC SYSTEM

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***Abstract*- Loss of life inside an enclosed car cabin due to the suffocation though rare but it is evident and phenomenal all these days. Inside a closed space or cabin, People inhale their own exhaled air that carries a greater proportion of carbon dioxide (CO_2). In addition to this, the case of oxygen gas getting depleted leads to further increase of suffocation. So in order to help people, infants, pets who/which get caught in these unavoidable and unexpected situations, this project gives a solution that may prevent people from reaching fatal situations. A simple concept of air diffusion from region of higher concentration to lower concentration is used here. The theme of the project is to detect the critical suffocating level of CO_2 and prevent suffocation by automatically controlling the power windows of the car to shut open, thereby allowing fresh air to come inside the car cabin and avoiding suffocation. In this project a cubical glass tank as a substitute for car cabin and carbon dioxide cylinder as a source of CO_2 for our experimental purpose and convenience. Here gas sensors are used to sense the level of CO_2, the sensor gives the signal to Arduino UNO chip. Arduino sends signal to the DC motor of the power window. The entire setup is run by a 12V battery. Once the DC motor receives the signal from Arduino, it runs and pulls the window down. In real life application the sensor and controller are replaced by a printed circuit board which comes as a part of the car management system.**

Keywords- Carbon dioxide, diffusion, suffocation, ardunio, sensors

I. INTRODUCTION

There have been a significant number of fatal accidents due to suffocation taking place inside a car cabin. This may be due to a variety of factors such as inhaling the exhaled CO2 gas, leakage of CO from the air-conditioning vents, unable to escape from a car with jammed doors and windows. This project focuses on one such issue in which people who are unable to physically engage the window like infants, paralyzed people, cardiac and asthmatic attacked people and pets left behind in cars. These causalities are in therisk of inhaling their exhaled air continuously for a certain period which subsequently leads to fainting and even death.

Exhaled air is about 5% CO_2. Inhaling all the air exactly once would put the entire car's volume at 5% CO_2.10% CO_2 is fatal but death due to lack of oxygen will take place well in advance. The human body cannot actually detect lack of oxygen. All breathing-related reflexes are triggered by CO_2 concentration. It is an incredibly unpleasant sensation.

1.1 INCIDENTS

There are many incidents of people and pets losing their life due to air suffocation inside a car cabin as shown in Figure 1.1, 1.2. A few incidents are listed below.

Toddler, 2, Dies inside car with AC running in Chennai

A ten-minute meeting stretching to an hour meant his son spent one hour locked inside a car with the AC running. The boy was found unconscious and was declared dead when taken to a hospital. He had kept the air conditioner on to keep his son comfortable, only to find him dead after a hour.

Figure 1.1 Human suffocation

Four children suffocate to death in locked Tamil Nadu car

Four children who climbed into a stranger's unlocked and parked car have died inTamil Nadu on August 2014. The children were between 4 and 10 years old andwere attending a temple festival with their parents at Vedanatham village in theTuticorin district of Tamil Nadu. The car they entered was parked at a yard filledwith cars seized from bank loan defaulters, the police said.

Boy Gets Locked Inside Car, Dies of Suffocation in Bhopal

A two-and-a-half-year-old boy died allegedly due to suffocation after he accidentally locked himself in a car in busy New Market area of Bhopal. The incident took place yesterday when the boy. son of a local garment trader, was playing in a shop. He took the keys of the car and went inside the vehicle to play Soon after the child entered inside, the car got locked and the windows remained closed causing suffocation After nearly two hours when his mother came down searching for him to the shop on the ground floor, the child was found lying unconscious. Subsequently, the vehicle was opened with a duplicate key and he was rushed to a hospital where he was declared brought dead.

Figure 1.2 Infant gets locked inside the car 2 Children Die of Suffocation in Locked Car in Jaipur

Two children, aged four and eight, suffocated to death after they accidentally locked themselves inside a car in Pugia village in Jaipur. They got into their neighbor's car while playing and accidentally locked it from inside. They fell unconscious and suffocated to death a few hours later. They were found by the car owner and rushed to hospital. where they were declared dead on arrival.

130 cases of children left in locked cars between January and November 2014

A member of the Federal National Council and a road-safety expert have calledon parents to be more vigilant after police revealed 130 cases of children beinglet alone in cars so far this year. The calls were made after Dubai Police revealedthat 113 children had to be rescued from locked cars between January andOctober. And that number had increased to 130 in just a few weeks.

1.2 CAUSES OF DEATH

The main cause of death due to suffocation in locked cars id due to lack of oxygen and increased percentage of Carbon dioxide (CO). A high concentration can displace oxygen in the air. If less oxygen is available to breathe, symptoms such as rapid breathing, rapid heart rate, clumsiness, emotional upsets and fatigue can convulsions, coma and death can occur. Symptoms occur more quickly with physical effort. Lack of oxygen can cause permanent damage to organs including the brain and heart. Direct contact with the liquefied gas can chill or freeze the skin (frostbite). Symptoms of mild frostbite include numbness, prickling and itching. Symptoms of more severe frostbite include a burning sensation and stiffness. The skin may become waxy white or yellow. Blistering. tissue death and infection may develop in severe cases.

1.3 PREVENTIVE MEASURES

Even though Automobile industry has evolved considerably in last century, still hundreds of deaths mainly children occur when car is stationary with windows closed. As even most advanced of cars are Air-tight and does not provide any air to passenger stuck inside car when engine is off and as a result the struggling passenger dies of suffocation. Some of the measures taken are listed below.

1.3.1 In-Car suffocation prevention using image motion detection

A video based system to automatically check whether there is any human left in the car when the engine has been turned off if proposed to solve this problem. A simple edge and

TABLE 1.1 COMPONENTS USED

S.NO.	ITEM	TYPE	SPECIFICATION
1.	Gas Sensor	MQ135	Senses harmful gases
2.	Controller	Arduino UNO	Interfaces input and output signal
3.	Motor	12V DC motor	Driver
4.	Motor controller	L298N dual motor controller module	Interfaces digital output from controller and converts to analog signal from motor

		– 2A	
5.	CO_2 source	CO_2 gas tank	Source of CO_2
6.	Experimental space	Cubical glass tank	Space for testing
7.	Gas outlet regulator	Single step pressure regulator	Regulates mass flow rate of CO_2
8.	Gas passage	Hose	For CO_2 flow
9.	Current passage	Jump wires	For power flow
10.	Power distributor	Bread board	For distribution of power
11.	Power source	12V DC battery	Source of power for entire circuit
12.	Car window	Tata Indica driver seat window	Output

II. DESIGN CALCULATIONS

2.1 DESIGN CALCULATIONS

The preset and pre-researched allowable levels of CO_2 in the atmosphere for human survival and the CO_2 PPM level calculations according to the chosen test space is calculated and discussed.

2.2 CO_2 PPM LEVEL CALCULATION

Suppose we are given parts per million measurements (ppm of X in Y) and we want to convert that to a percent concentration of X in Y. % Concentration = 10,000 ppm

From the threshold level of CO2 that causes suffocation, which we already know, i.e., 40000 ppm.

Therefore,

$$\% \text{ Concentration} = \frac{40{,}000}{10{,}000}$$

$$\% \text{ Concentration} = 4\%$$

For testing purpose, a cubical glass tank is used, which is of dimensions,

length = 30cm
breadth = 30cm
height = 30cm

The volume of the cubical glass tank is, volume = length * breadth * height

$$\text{volume} = 30 \times 30 \times 30$$

$$\text{volume} = 9000 \text{ cm}^3$$

$$4\% \text{ of volume of cubical glass tank} = \frac{4}{} * 9000$$

4% of volume of cubical glass tank = 360 cm^3 The CO_2 sensor is programmed to sense the level of CO_2 once it reaches 40000ppm or 4% of the test volume i.e., 360 cm^3. The below figure shows the gas distribution in a closed cabin.

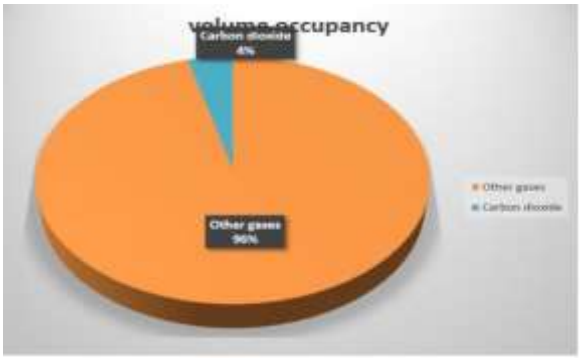

Figure 4.1 Gas concentration

III. FABRICATION DETAILS

This chapter focuses on the hardware arrangement and assembly of all the mechanical and electrical components together to form a closed circuit, including the PIN diagram for the bread board.

3.1 CONTROL SYSTEM

A control system in mechatronics refers to a group of physical components connected in related in such manner to command or direct or regulate itself or another system. The physical components may be electrical, mechanical, hydraulic, pneumatic. thermal or chemical in nature. Accordingly, they are classified as,

1. Open loop control system
2. Closed loop control system

3.2 OPEN LOOP CONTROL SYSTEM

Open loop control systems are systems in which the output of the system is not used as variable to control the system. In other words, open loop system are systems in which input of the system is not controlled by the present output as shown in Figure 5.1.

3.3 CLOSED LOOP CONTROL SYSTEM

Closed loop control systems uses on a feedback loop to control the operation of the system. In closed loop or feedback control, the controller notices what actually takes place at the output and it drives the plant in such a way to obtain the desired output as shown in figure 5.2.

3.4 ASSEMBLY

- The regulator valve is attached to the head of the CO_2 cylinder.
- A hose is connected to the other end of the regulator valve.
- CO_2 sensor is fit in the small hole provided on the top of the glass tank.
- Breadboard acts a base and power distributor.
- The output from the Co_2 sensor is fed as input to the Arduino UNO board.

- From the Arduino board a connection is made to the L298N motor drive
  which is in turn connected to the DC motor of the power window.
- Arduino program is fed into the system by a computer.
- A 12V DC battery runs the entire setup.

3.5 PHYSICAL DIAGRAM

The physical diagram as shown in Figure 5.3. represents the entire assembly of the project.

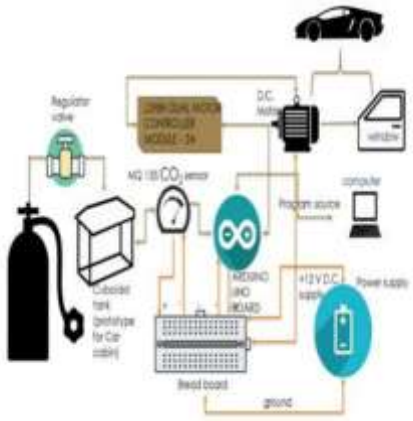

Figure 3.1 Physical diagram of the assembly

3.6 CIRCUIT DIAGRAM

The circuit diagram as shown in Figure 3.1. depicts the wiring of the system

3.7 CIRCUIT CONNECTIONS

- 5V D. C. power supply is given to the MQ35 CO_2 sensor. Arduino UNO. L298N motor control module using breadboard.
- Similarly, all the three circuits are grounded to the common negative terminal using breadboard.
- Analog output (AO) from MQ135 CO_2 sensor is given as input to analog input pin (A0) of Arduino UNO.
- Digital outputs from Arduino UNO 7,8 pins are wired to N3 and N4 leads of L298N motor control module.
- Digital output which controls motor speed using pule width module (PWM) from pin 10 of Arduino UNO is wired to enable pin (ENB) of
  L298N motor control module.
- 12V D. C. Supply is given as another input to L298N motor control
  module.
- Finally output 3 and 4 of L298N motor control module are wired to the input terminal of 12V D. C. Motor of power window.

3.8 WORKING

- Glass cabin is used in order to have a constant volume of 30 x 30 x 30 cubic.cm.
- Two holes are made on top side of the glass tank. one for the CO_2 sensor and other for the CO_2 gas supply.
- As the air from the CO_2 tank is released into the glass tank, the sensor senses the pre-set threshold level of CO_2 and sends a digital signal to the Arduino UNO pin 8.
- Arduino UNO is programmed using Arduino UNO compiler in computer and later uploaded using USB interfacing.
- Arduino Board after receiving input signal from sensor, sends an output digital signal to L298N dual motor controller module-2A.
- L298N dual motor controller module-2A controls the DC motor of power window by establishing connection between battery and motor of power window.
- Once the motor is actuated, the power window goes down. letting in fresh air. The Arduino board, L298N dual motor controller module- 2A DC motor, CO_2 sensor all are connected to breadboard.

IV. RESULTS AND DISCUSSION

RESULTS

As soon as the CO_2 cylinder is opened, CO_2 gas fills inside the cubical glass tank. The Arduino UNO board which is pre-programmed to instruct the sensor to send the signal once the CO_2 level reaches the maximum or threshold limit which is 4% of the test specimen volume or 360 cm^3. Consequently, the Arduino UNO board instructs the L298N motor driver module to operate or actuate the DC Motor of the power window. This lowers the wind shield.

In the actual scenario, the entire circuit gets replaced by a printed circuit board (PCB) which has inbuilt pre-programmed chips, controller and other components. It comes as a part of engine management system as shown in Fig.7.1, the power window of the car lowers and hence the concentration of CO_2 reduces inside the car cabin and fresh atmospheric air enters inside the car, preventing trapped causalities from suffocation.

Figure 4.1 Actual versus experimental scenario

4.2 FUTURE ADVANCEMENTS

- Future development may include alerting the environment people by producing alarm sound and hitting parking lights.
- Additional improvisation may include carbon monoxide detection which is highly

fatal than carbon dioxide even in small quantities, which is leaked through the AC vents when the AC is switched ON when the car engine is OFF.

- Thermal sensing to avoid fire accidents inside the car may also be added as an extension to this setup in order to enhance the smartness of the car.

V. CONCLUSION

This method proves to be efficient and quick to save lives during such fatal situations. It improves the safety inside the car even without human interference. It enables integration of electronic system to the mechanical window of the car which has enhanced the safety of the passengers in a more economical way. This also saves precious lives of the living beings, by preventing them from suffocation and death. In actual scenario the entire Arduino UNO, sensor and battery setup is replaced with Printed Circuit Board (PCB) which is a part of car management system.

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