DEVELOPMENT OF A SYSTEM TO PREVENT SUFFOCATION IN A PARKED CAR

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ABSTRACT

Across the globe, several infant children's deaths have been reported after left in a parked car because of the suffocation inside the car cabin. This Situation occurs due to excess inhalation of the same air exhaled by their body which results into depletion of oxygen inside the victim's body. This paper aims to show how the suffocation inside the car cabin can be maintained automatically by the installation of suffocation prevention system. This mainly consists of carbon dioxide and motion sensor, relay module and a programmable Arduino UNO board which is the heart of the system which commands all the parts to act accordingly. When the level of carbon dioxide increases and motion is present in the car cabin, the sensors detect this situation which are connected to the Arduino board. It further gives the signal to the relay module which is directly connected to the fan and turns it on in order to provide the air circulation inside the car. Thus, it will prevent the suffocation through air circulation even though the car is off. To check the concept tangibility, first a model was prepared which was followed by actual setup and experimentation in a car. The entire setup runs on a 12V battery present inside a car. In market, there is huge demand of a system with high efficiency as well as minimum fuel consumption. Study concludes that without using any fuel, the problem of oxygen depletion in the person locked inside the passenger cabin in parked car can be solved by using this suffocation prevention system.

KEYWORDS

Anti-Suffocation , Oxygen Control, Parked Car, Passenger Cabin, Sensors and Cooling Fan, Air Circulation, Mechatronic System

INTRODUCTION

If a person does not obtain oxygen within a few minutes, they will suffer permanent brain damage or die. When your body doesn't get enough oxygen to prevent you from passing out, it's called asphyxia. It's a potentially fatal scenario. Being stuck in a closed car can eventually decreases the oxygen level and can easily cause asphyxia. Globally, many death cases have been reported frequently of infants left in a parked car. The main symptoms of asphyxia are Shortness of breath, slow heart rate, loss of consciousness. (i) According to The Indian Express, two girls, aged four and seven years, died of suffocation after getting locked in a damaged car in Kallakurichi district of Tamil Nadu on 25th July 2020. (ii) A six-year-old boy suffocated to death after accidentally getting trapped inside a car parked by the roadside for a few hours in Ahmedabad, Gujarat on 6th September 2020. He appeared to have died of suffocation as he remained locked inside the car for a few hours. (iii) Three children died of suffocation in a car after getting trapped inside, in a village in Krishna district in Andhra Pradesh on 6th August 2020. Despite the fact that many advancements have been made in the car industry to improve people's comfort, fatal accidents continue to occur. Thus, the automobile industry is focusing more on the safety advancements as per the customer requirements. The main objective of the paper is to show this project can prevent such incidents globally and increases safety in car by creating a system which can work fuel efficient and can provide air circulation inside the parked car. This system can be installed in any car as it works on the basic principle and it is very easy to install. The total components used in the experiment are Arduino

UNO Programmable broad, car cooling fan, a motion sensor, a carbon dioxide sensor, relay module, car battery, jumper wires, a buzzer and connecting wires. Previous solutions for this suffocation problem were entirely focused on opening of windows to prevent the suffocation in the car cabin in a closed car. This solution may result in many risks including the safety of the things kept as well as infants/pets stuck inside the locked car. They may become a victim of kidnapping or theft by any strangers. Thus, this system is developed which works with the Car blower AC fan present inside the car in order to prevent such incidents. The circuit diagram was prepared after which these components were connected accordingly. Before directly applying this concept on a car, we prepared a model to check whether the concept is tangible or not. Whenever there was a rise in carbon dioxide level while providing motion, the relay module switches the car fan as well as the exhaust fan automatically starts as programmed in Arduino microcontroller. After the experimentation on the model the same actual scenario was conducted on car.

MATERIALS USED:

I. Carbon Dioxide Sensor (MQ135):

The carbon dioxide gas sensor detects the amount of IR radiation absorbed by carbon dioxide molecules to determine gaseous carbon dioxide levels. MQ135 is an air quality sensor that can detect carbon monoxide, carbon dioxide, alcohol, benzene, ammonia, and nitro oxide, among other gases.

II. Arduino Uno R3

The Arduino Uno R3 is a microcontroller board based on a removable, dual-inline-package (DIP) ATmega328 AVR microcontroller. There are 20 optical input/output pins on it (of which 6 can be used as PWM outputs and 6 can be used as analogue inputs). It can be programmed using the Arduino programming software, which is simple to use.

III. PIR Sensor

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out.

IV. 1 channel 5V relay module:

A relay is a device that enables a low voltage to regulate higher-power circuits. A relay accomplishes this by energising an electromagnet with 5V from an Arduino screw, which then closes an internal, physical switch to turn on or off a higher-power circuit.

V. 12V Cooling Fan:

Car air conditioning is a system within your car which uses the cooling fan that helps you to cool the interior air of the vehicle in hot weather, providing for a cooler environment for the occupants. It works with the blower motor which is used to provide air circulation in order to prevent suffocation or to flow the AC cooled air inside the car.

VI. 12V Car Battery

A car battery, also known as an electric battery, is a rechargeable battery that is used to start an engine. Its primary function is to provide electricity to the electric-powered starter motor, which then starts the chemically-fueled internal combustion engine that propels the car.

VII. Buzzer

A buzzer or beeper is an audio signaling device, which is mechanical, electromechanical, or piezoelectric. It is a small yet efficient component to add sound features to our project/system.

VIII. Jumper wire

A jump wire is an electrical wire, or group of them in a cable, with a connector or pin at each end, which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components like Arduino Board, Relay Module, Sensors and cooling fan, without soldering.

DESIGN AND ASSEMBLY

Assembly:

Arduino Uno R3 Microcontroller is the heart of this assembly which is connected to all the parts including CO2 MQ135 sensor, PIR motion sensor, Relay Module, Car battery, Ac fan, buzzer through the Jumper wires as shown in figure. The motion and the CO2 sensor is only connected with arduino controller individually which is further connected with the relay module, buzzer and 2 cooling fans. The other end of relay module is connected to the 12V car AC fan as well as the exhaust fan. The buzzer is attached to arduino which provides sound signal according to the sensor outputs. Jumper wires are used to connect all the components within the system. The power to the entire setup is provided to microcontroller with a 12V DC Battery present inside a car.

Design:

A model was prepared before directly setting up in a car for experimental purpose by setting up all the components on a board. The circuit diagram needed to create this model was prepared in autoCAD. The circuit diagram connecting all the components is shown in the figure 1.

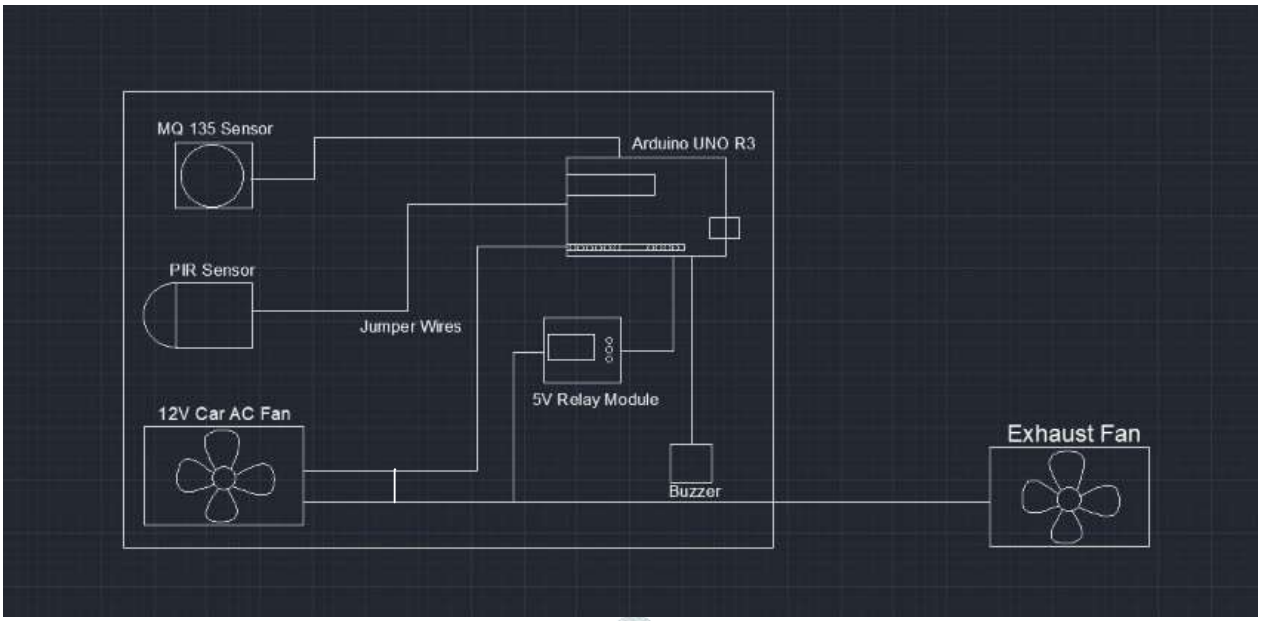

Figure 1 : 2D Design of Model in AutoCAD

The actual model was successfully created based on this diagram as mentioned below in figure. As you can see all the components are connected accordingly with jumper wires.

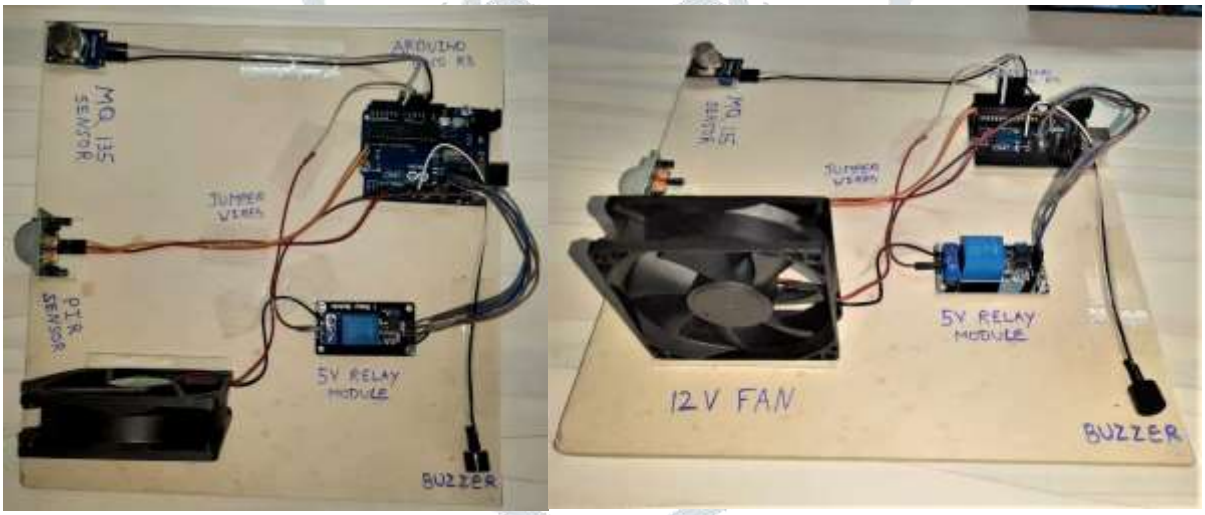

Figure 2 : Actual Model

According to this model, we set up this components as a prototype inside the car using long connecting wires. The Arduino UNO microcontroller recieves power from an external 12V DC battery which is further connected to all the components inside the car cabin. The exhaust fan is attached at the rear side of the car in a small vent which is also connected to the relay module as well as the microcontroller.

WORKING:

Working Objective and Description:

The main goal of this system is to provide the air circulation inside the car in order to prevent the suffocation using all the componnets mentioned above. The system initiates the process when the motion is present which is sensed by the PIR sensor as well as when there is a rise of carbon dioxide level inside the car cabin. As soon as both the sensors senses the motion and rise in carbon dioxide level inside the car cabin it gives the signal to Arduino microcontroller.

The Arduino microcontroller after receiving the input signal from the sensors further sends an output signal to the 1 channel relay module and the buzzer. The Relay module acts as a switch which aims to open and close an circuit electromechanically for both the fan attached as shown in below figure.

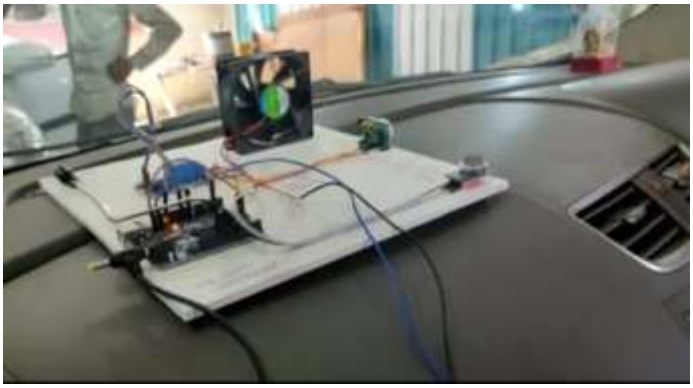

Figure 3 : Actual Working Model

Figure 4 : External 12V DC Battery

As soon as the fans receive the input signal from the relay channel, they starts rotating which provides the flow of air inside the car cabin. The buzzer which is connected to the Arduino UNO also receive the signal simultaneously and immidiately produces the beep sound helping the user know when the system works.

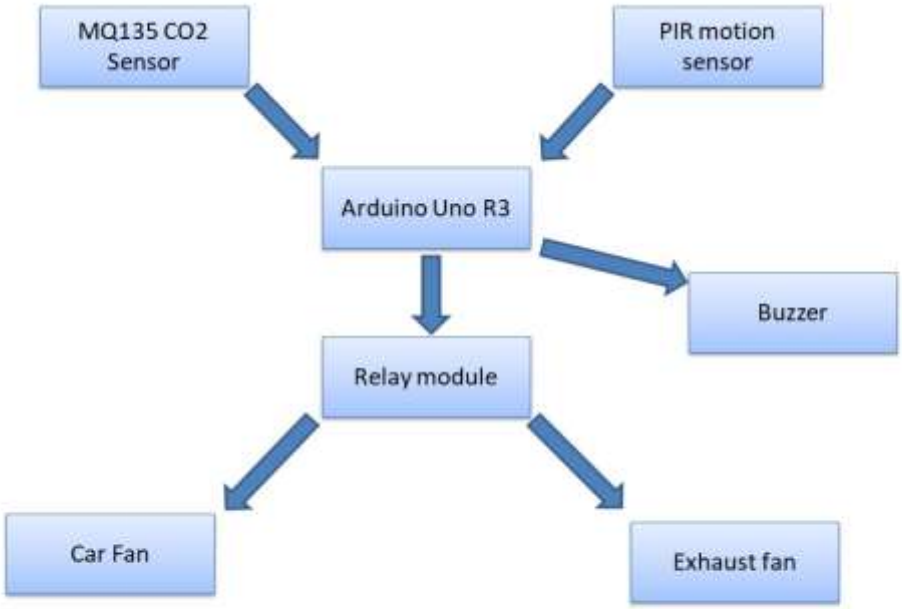

Figure 5 : Functional block diagram

As mentioned above, there are two fans installed in the system. One is the car AC blower fan which is already prensent inside and car and the other is attached in a small vent at the rear side of the car which acts as an exhaust fan.

Figure 6 : Exhaust Fan

When the relay module recieves signal from the microcontroller, it switches both the fans in which the first car fan blows the air inside the car whereas the other fan throws the air out of the car throught that small vent. Thus, it will provide the air circulaton inside the car which will prevent the suffocation inside the car cabin. It will result in the decrease in carbon dioxide level and will maintain the oxygen level so that the passenger will not feel any hesitation to breathe.

Programming:

```
const int PIR_SENSOR_OUTPUT_PIN = 2

int warm_up;
```

```
int buzzer = 8
int mq = A0
int sensorThres = 2000;
int relay_pin = 10;
void setup()
{
pinMode(PIR_SENSOR_OUTPUT_PIN, INPUT);
pinMode(buzzer, OUTPUT);
pinMode(mq, INPUT);
pinMode(relay_pin, OUTPUT);
digitalWrite(relay_pin, HIGH);
noTone(buzzer);
Serial.begin(9600)
delay(15000);
}
void loop() {
int sensor_output;
sensor_output = digitalRead(PIR_SENSOR_OUTPUT_PIN);
if ( sensor_output == LOW )
{
noTone(buzzer);
digitalWrite(relay_pin, HIGH);
if ( warm_up == 1 )
{
Serial.println("Warming Up");
warm_up = 0;
delay(2000);
}
Serial.println("No object in sight");
delay(1000);
}
```

```
else
{
Serial.println("Object detected");
warm_up = 1;
int mqval = analogRead(mq);
Serial.println("Sensor value ");
Serial.println(mqval);
if (mqval > sensorThres)
{
tone(buzzer, 1000, 200);
digitalWrite(relay_pin, LOW);
}
else
{
noTone(buzzer);
digitalWrite(relay_pin, HIGH);
}
delay(5000); //
}
}
```

EXPERIMENT AND CALCULATIONS:

Experimental Table 1:

Sr No.	No. of people	No. of Cycles (n)	Cycle Time (t)	Total time (t_n)
1)	3	5	15.5 sec	77.5
2)	2	4	15.5 sec	62
3)	3	4	15.5 sec	62
4)	4	5	15.5 sec	77.5

Table 1 : Time observation of cooling fan

Experiment Table 2:

Time of Experiment	Environment Temperature (T_0)	Pre Temperature in Car (T_1)	Post Temperature in Car (T_2)	Car Fan time (t)
10:00	31°C	34°C	32°C	60 sec
15:00	40°C	48°C	44°C	60 sec
19:00	36°C	43°C	40°C	60 sec
22:30	32°C	33°C	32°C	60 sec

Table 2 : Temperature Variation Analysis

Results And Discussion

The experimentation was carried out by four people in order to know the total time the fan takes to reduce the CO2 level by providing air circulation inside the car cabin in a parked condition.It was noticed in experiment 1 that with the increase in no. of people the total time the fan takes also increases remarkably. The one cycle time of fan is 15.5 seconds. The no. of cycle also rises directly with respect to no. of people.

Increase in no. of people $\propto$ No. of Cycles $\propto$ Total time

In experiment 2 analysis of temperature variation at different time is carried out in which it is noticed that by the air circulation of cooling fan the car temperature tends to come near the environmental temperature as shown in table 2.

CONCLUSION

Thus it can be concluded from this proposed idea, with the installation of this system consisting sensors, major causes for the car incidents can be minimized. It successfully provides air circulation and prevents suffocation inside the car cabin in a parked car even when the car engine is off. This system proves to be cost effective, easy to install and highly reliable. Moreover, the inner atmosphere of car is maintained automatically by cooling fan immediately after it senses the rise in CO2 level when the motion is present. The experiments result shows that by the air circulation inside the car cabin, the inner atmosphere becomes stable and breathable. Thus, improving the safety factor of person present inside the car in such critical situation makes the system more intelligent and humanized.

Advantages:

The problem of **overheating** of the car cabin will also be solved when the two fans will provide the air flow in the car. This system totally works on a battery so no fuel is being used in the process even when the system is working in a closed car. The small size of all the components makes the system compact. Thus, it can be installed in any car without taking up much space. All the equipment used in the project are very cost effective.

Installation of this system in any car is much easy and not complicated. The car battery which is being used to run this system will automatically be charged by the alternator present inside the car when the car runs.

Future Scope:

With this device in mind, a sensor that can quickly scan the pulse rate or measure the respiration rate can be created. This will not only alert the driver to the fact that someone is suffocating in the vehicle, but it will also alert the driver if someone is having a panic attack or experiencing some trouble that causes his/her/respiration it's rates to increase. Grace Wusk and Hampton Gabler suggested a method for detecting respiratory and heart rates in a car accident using a seat monitor. The proposed technique can be improved for anti-suffocation in smart car systems using this approach.

The area can be alerted in the future by making a warning sound and hitting parking lights. Additional improvisations could involve carbon monoxide detection, which is more deadly than carbon dioxide even in small amounts and is emitted through the AC vents when the car engine is turned off. Thermal sensing to prevent fire accidents inside the vehicle may also be applied as an add-on to this configuration to improve the car's smartness.

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