CARBON MONIXIDE DETECTOR

ABSTRACT

Living in a city is very convenient under many points of view such as high-levels in education, services and entertainment but is also inconvenient in other ways.

In many heavily urbanized areas, particularly in the developing world such as China, India and Brazil, carbon monoxide detectors often register levels many times higher than accepted “safe” levels.

It is evident that we cannot list all the major cities in the world but we can for sure find a common term between all of them. Metropolis like London, Paris and New York are connected to Asian (mega) cities like Hong Kong, New Delhi and Tokyo because of pollution.

Since the 1970s, more and more people (like scientists, politicians and workers) started to get interested and sensible to the effects of pollution on human beings, for example, the verified correlation between the cancer and places in which smoking was allowed has led to anti-smoke laws.

But, how this problem is connected to our project?

Because as with every problem, the initial step is to recognize it understand its causes. How can you state, in an objective way, if the air of a place is unhealthy or not?

Well, indicators are a good way and, in particular, the Carbon Monoxide (**CO**) is considered by the scientists as one of the most polluting and dangerous chemical agents.

That’s why we have choosen to implement a carbon monoxide sensor. Basically it is “portable” and it will measure the concentration of this compound in several places.

STATE OF THE ART

A carbon monoxide detector is a device that detects the presence of the carbon monoxide (CO) gas to prevent carbon monoxide poisoning, which occurs from breathing air with high levels of CO.

Since it is produced by fuel-burning appliances and since the it is an odorless, tasteless and colorless gas it is also called the “silent killer”.

CO detectors are designed to measure CO levels over time and sound an alarm before dangerous levels of CO accumulate in an environment, giving people adequate warning to safely ventilate the area or evacuate.

It is important to notice that actually are sold combined version of both smoke and CO detectors, that’s because, for example, in our home some common sources of CO include open flames, space heaters, water heaters and blocked chimney and, also, a car inside a garage.

The average cost of this type of device varies from $15 - $60 USD, but, some companies as Google are producing devices that detect CO, smoke and fire and then notify it on smartphone using your own wifi, in this case, the price is higher than $100 USD.

Most of the CO detector's market is focused on the household sector and several types of detectors have been developed in these years:

1) Biomimetic sensors: use a combination of color-changing liquids or gel-like elements to detect carbon monoxide;

2) Semiconductor sensors: created using wired circuits to monitor carbon monoxide;

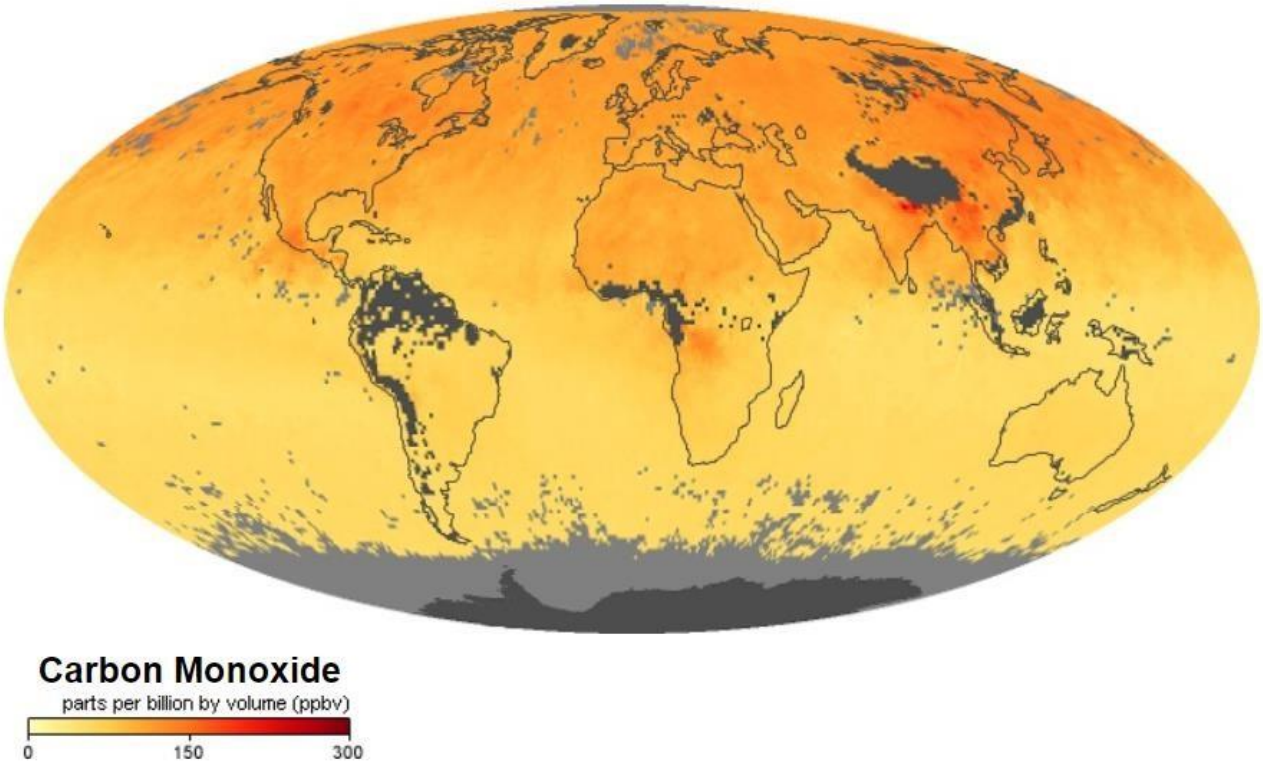
3) Electrochemical sensors: generate currents that show the amount of carbon monoxide detected when the gas undergoes a chemical reaction;

4) Opto-chemical sensors: consist of a pad of a coloured chemical which changes colour upon reaction with carbon monoxide.

Our model needs 4 AA batteries to work.

MORE ON CARBON MONOXIDE

The map shows the average of global concentrations of tropospheric carbon monoxide at an altitude of about 12,000 feet. The data were collected by the MOPITT (Measurements Of Pollution In The Troposphere) sensor on NASA's Terra satellite. Concentrations of carbon monoxide are expressed in parts per billion by volume (ppbv). A concentration of 1 ppbv means that for every billion molecules of gas in the measured volume, one of them is a carbon monoxide molecule. Yellow areas have little or no carbon monoxide, while progressively higher concentrations are shown in orange and red. Places where the sensor didn't collect data, perhaps due to clouds, are gray. In different parts of the world and in different seasons, the amounts and sources of atmospheric carbon monoxide change. In Africa, for example, the seasonal shifts in carbon monoxide are tied to the widespread agricultural burning that shifts north and south of the equator with the seasons. Fires are an important source of carbon monoxide pollution in other regions of the Southern Hemisphere, such as the Amazon and Southeast Asia. In the United States, Europe, and eastern China, on the other hand, the highest carbon monoxide concentrations occur around urban areas as a result of vehicle and industrial emissions. Fires burning over large areas in North America and Russia in some years can be an important source. The MOPITT observations often show that pollution emitted on one continent can travel across oceans to have a big impact on air quality on other continents. Carbon monoxide is a trace gas in the atmosphere, and it does not have a direct effect on the global temperature, like methane and carbon dioxide do. However, carbon monoxide plays a major role in atmospheric chemistry, and it affects the ability of the atmosphere to cleanse itself of many other polluting gases. In combination with other pollutants and sunshine, it also takes part in the formation of lower-atmospheric ("bad") ozone and urban smog.



LEGISLATIONS

On 31 January 2017, the European Union (EU) Commission adopted the Directive 2017/164 establishing new indicative occupational exposure limit values for a list of chemical agents.

In the USA, particularly in New York, California and Maine, the CO detectors must be installed in the households and other regulations about these devices affect at least 32 states. The devices can be placed both near the floor and near the ceiling since the density of the CO can change in the air.

Further, US and Canada have stipulated the writing of CO standards, which set the minimum level of CO that can be showed by displays at 30 ppm , while an alarm will not sound at CO concentration up to 70 ppm.

Below the table that shows some negative effects of the CO on the human body:

CONCENTRATION OF "CO" IN THE AIR	SYMPTOMS ON HUMAN
100 ppm (0,01%)	Light headache in 2-3 hours.
400 ppm (0,04%)	Light headache in 1-2 hours, rising after 2-3 hours.
1600 ppm (0,16%)	Headaches, dizziness and nausea in 20 minutes, dying within 2 hours.
6400 ppm (0,64%)	Headaches and diarrhea in 1 or 2 minutes, death in 10-15 minutes.
12800 ppm (1,28%)	Death in 1-3 minutes.

LIST OF COMPONENTS

BreadBoard - Half Size
$4.5 x Qty: 1

Arduino Uno
$23.38 x Qty: 1

Battery Holder - 4xAA
$1.74 x Qty: 1

Carbon Monoxide Sensor - MQ-7
$5.99 x Qty: 1

RGB Led Common Anode
$1.89 x Qty: 1

220 Ohm Resistor
$0.1 x Qty: 1

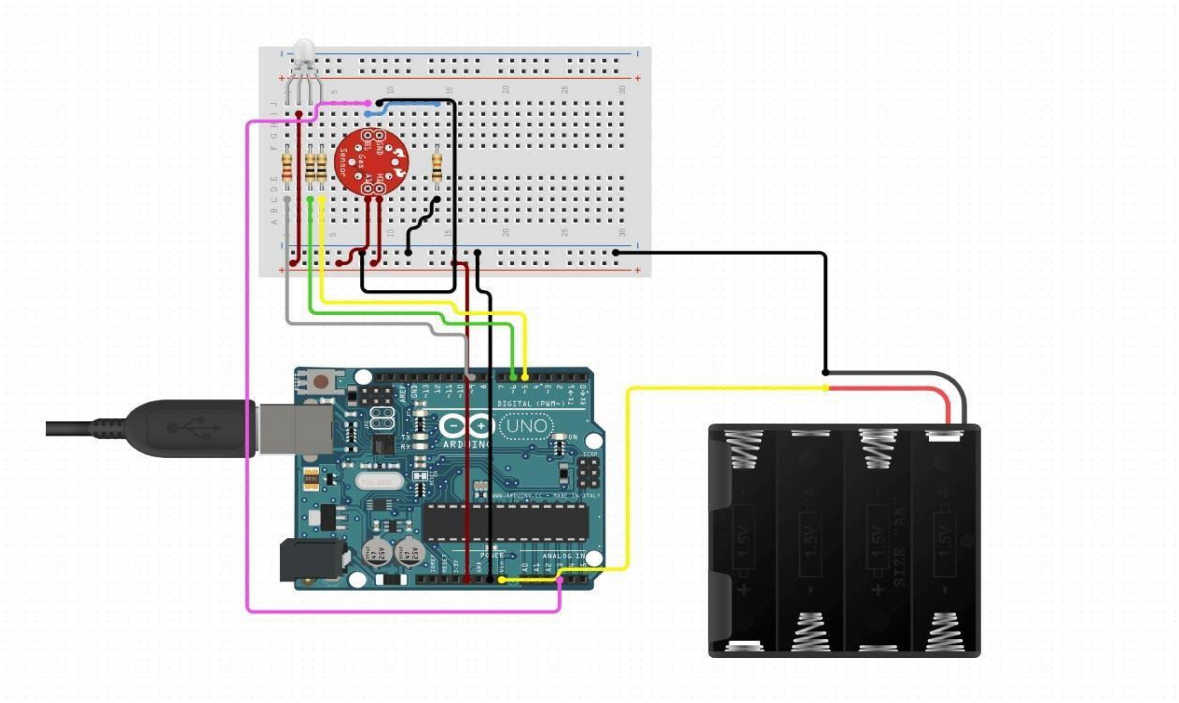
100 Ohm Resistor
$0.1 x Qty: 2

USB Cable A to B
$3.26 x Qty: 1

Gas Sensor Breakout Board
$0.95 x Qty: 1

Jumper Wires Pack - M/M
$1.95 x Qty: 1

Male Headers Pack- Break-Away
$0.66 x Qty: 1



The MQ7 CO detector is an analog component therefore, it is connected to the Arduino ADC pin. The values read by the Arduino will be in the range between 0 - 1023.

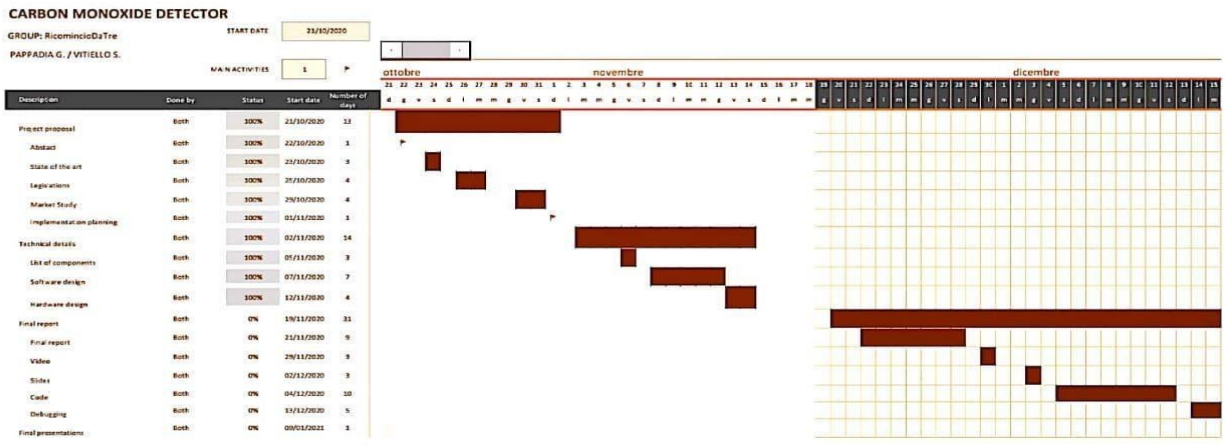
In order to translate the ADC values to PWM values (required by the LED) from 0 - 255, we use the map() function, which is then stored in “mq7Val” variable.

Using this variable, we can determine the color we want to control on the LED – Red, Green or Blue. The color and intensity of the LED will change according to the CO detector readings and the color we decided to control.

We can claim that the LED will be Red when the levels of CO are too high and green when not.

The entire codes for the MQ7 sensor, the analog reader and the RGB sensor will be written in C++ and then all will be implemented through a “ .ino ” code.

GANNT DIAGRAM



BIBLIOGRAPHY

https://earthobservatory.nasa.gov/global-maps/MOP_CO_M#:~:text=Colorless%2C%20odorless%2C%20and%20poisonous%2C%20carbon%20monoxide%20is%20one,burn%20incompletely%20or%20inefficiently%2C%20they%20produce%20carbon%20monoxide.

https://informarexresistere.fr/evitare-di-morire-per-il-monossido-di-carbonio-tutto-quello-che-ce-dasapere/

https://cpftecnogeca.com/images/Istruzioni/Italiano/BETA762CO_0134183.pdf#:~:text=Il%20Monossido%20di%20Carbonio%20%C3%A8%20un%20gas%20molto,un%20lungo%20periodo%20nausea%2C%20cefalea%2C%20perdita%20di%20coscienza

https://bestofmachinery.com/best-carbon-monoxide-detector/#:~:text=%20View%20the%20Best%20Carbon%20Monoxide%20Detector%2C%20Below.,PRICE%20Protect%20your%20family%20from%20the...%20More%20