INTRODUCTION

As a research intern at CSIR – Central Electronics Engineering Research Institute, we are working in the field of smart sensors under the guidance of Dr Vijay Chatterjee, Scientist, CSIR-CEERI on a project named **"To Detect The Presence Of CO_2 Gas Using NDIR Gas Sensor."**

NDIR is an industry term for "non-dispersive infrared" and is the most common type of sensor used to measure carbon dioxide, or CO_2. However, this gas detector is not limited only for CO_2 gas but can be used to detect any IR- Active gas like CO, NO, SO_2 but at different wavelengths of Infrared Radiation. It is called as Non-Dispersive because the IR light which passes through the gas chamber is not pre-filtered.

In NDIR Gas Sensors, generally two main things happen:

1. Beer-Lambert Law
2. IR-Spectroscopy

Since, the Infrared Radiation passes through a cylindrical gas chamber, its intensity varies exponentially as the length of the chamber and the concentration of CO_2 increases. Thus, showing an application of Beer-Lambert Law. We can also see an interaction of IR light with the CO_2 gas molecules, so we can say there is an involvement of IR-Spectroscopy in this project.

NDIR gas sensor consists of an infrared source, detector, optical filter, gas cell, and electronics for signal processing. A single light source, dual wavelength type gas sensor has two detectors and two optical filters of different wavelengths which are placed in front of each detector. Before passing the CO_2 gas we see the decrease in intensity of IR radiation (in the absence of IR active gas). This decrease in radiation is because of the length of the gas cell. Now, we pass CO_2 gas through the inlet and simultaneously we pass the IR light, in this case the intensity of IR light decreases further because of the interaction of CO_2 gas molecules with the same. It may be noted that the Infrared Radiation of wavelength ranging from 0.7 µm to 1 mm is passed through the gas cell. However, the CO_2 gas molecules interact at a wavelength of around 4.26 µm causing vibration of the gas molecules.

Some, of the infrared light is absorbed by the target gas while some IR radiation passes without any absorption. One that is absorbed by a target gas passes through the active filter with a particular bandwidth for the detection of the target gas while the other which does not interact with the target gas passes through the reference filter. NDIR gas sensor detects the decrease in transmitted infrared light which is in proportion to gas concentration. The difference between transmitted light intensities in these two bandwidths is converted into gas concentration. In this way, we can calculate the concentration of CO_2 gas present in a gas chamber.

While there are multiple methods, through which a target gas can be detected by an NDIR gas sensor like using Photodetectors such as Photoconductivity Cell or using Thermal Detectors such as Pyroelectric detectors, Thermopile, Thermistor, Bolometer and Golay Cell. However, in this project we are limited only to pyroelectric detector for the detection of target gas.

This project finds multiple applications in industries as well as in normal households. It can also be used to track the concentration of CO_2 gas in a room present with NDIR gas sensor. As according to the World Health Organization, increased level of CO_2 gas in environment can increase the risk of transmission of SARS-CoV-2 virus. In any given indoor environment, when CO_2 level doubles, the risk of transmission also roughly doubles. The same has been confirmed by the researchers of Cooperative Institute for Research in Environmental Sciences (CIRES) and the University of Colorado Boulder. So, monitoring the level of CO_2 gas in a room through this project can be an inexpensive and wonderful way to prevent the transmission of Covid-19 virus.