Improving Air Quality in the Environment Using IoT and Drones

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Abstract: The current progress of the environment has a monster CO_2 issue. Carbon dioxide levels are the most elevated they've been in a huge number of years. Also, fundamentally, the pace of CO_2 expansion over the most recent 50 years isn't only extraordinary in mankind's set of experiences it's phenomenal in the geologic record. On the off chance that a worldwide society plans to avoid the most exceedingly terrible environmental change results, cutting CO_2 emanations implies chasing down the issue on various fronts: transportation, power, industry, and in any event, draining carbon out of the air. We propose a system using IoT devices with drones to identify carbon monoxide and assimilate carbon from the CO_2. That system will be converted from CO_2 into oxygen. It will be easily installed everywhere in the world, purify the air, and control Earth's warming.

Keywords: Carbon Dioxide (CO_2), Environment, IoT, Drone, Carbon Monoxide, Oxygen etc.

I. INTRODUCTION

In the present situation, the safety and welfare of human beings play a vital part in confirming that a safe protection classification is required, but with the improvement in expertise in current years, we stand ignoring to take care of the world in which we exist. As per the records from the WHO (World Health Organization) (2020), around 90% of the world's people live in zones where air pollution Greek crosses the boundaries established by WHO guiding principle. These consents are the living capacity of cutting-edge environments to be problematic thus, reducing the life expectation of humanoid beings by roughly at least 2 years [1]. Nowadays air pollution is infectivity outdoors as well as indoors due to by chemical, biological, or physical negotiator that changes the natural distinctiveness of the atmosphere. The major sources of air pollution are motor vehicles, household ignition, development of industries and forest firings, etc., and also pollutants in indoor and outdoor pollution cause different types of diseases and these are important sources of anguish and death. There are many ways that air quality can be polluted in modern times.

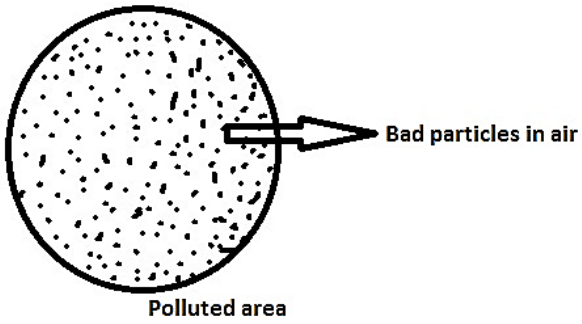

Fig 1: Pollutants in the air

Most of the common sources of air pollution include:

- *Transportation*: Vehicles like trucks, cars, trucks, and others emit pollutants into the air, together with nitrogen oxides, carbon monoxide, and particulate matter.
- *Industrial activities*: Power Plants and Factories emit a range of chemicals, together with nitrogen oxides, sulfur dioxide, and particulate matter.
- *Agricultural practices*: Farming activities can release pollutants into the air, including ammonia, pesticides, and dust.
- *Boiling of remaining fuels*: The combustion of coal, natural gas, and oil releases a variety of pollutants into the air, including, sulfur dioxide, nitrogen oxides, and carbon dioxide.
- *Construction and demolition*: Building and demolition activities can release dust and other particulate matter into the air.
- *Household activities*: Cooking, cleaning, and heating with wood or coal can also contribute to air pollution.
- *Wildfires*: Large-scale wildfires can release a significant amount of smoke and particulate matter into the air.

Overall, air pollution is a complex and multifaceted issue that requires a coordinated effort across multiple sectors to address. Once elements in the air are associated with ozone, they produce smog. Smog is a kind of airborne trash that looks like smoky mist and brands it problematic to see. We can observe the following picture to see the difference [2].

Fig 2: On a clear day after a rain (left) and on a smoggy day (right).

The World Health Organization (WHO) provides guidelines to protect the environment from pollution. Some of the key guidelines include: Improving air quality: Reducing emissions from transportation, industry, and energy production can significantly improve air quality. This can be achieved through the use of clean technologies, such as renewable energy sources and electric vehicles. Ensuring access to clean water: Access to clean drinking water is essential to protect human health and the environment. This can be achieved through the use of water treatment technologies and by reducing pollution from agriculture, industry, and other sources. Reducing exposure to hazardous chemicals: Hazardous chemicals, such as pesticides and industrial chemicals, can pose a significant risk to human health and the environment. Measures such as safer chemical production and use, as well as better waste management practices, can reduce exposure to these chemicals.
Improving waste management: Effective waste management practices, such as recycling and composting, can reduce the amount of waste sent to landfills and incinerators, thereby reducing pollution. Protecting biodiversity: Protecting biodiversity can help to ensure the health and resilience of ecosystems, which in turn can help to protect human health. This can be achieved through measures such as habitat conservation, ecosystem restoration, and sustainable land use practices. These guidelines aim to promote sustainable development and protect the health of both humans and the environment. But nowadays all of us omit these guidelines because of our comfort.

II. EXISTING SYSTEM

Among all the pollutants carbon monoxide is very dangerous and very harmful to human beings. So Carbon monoxide (CO) is a highly toxic gas that can pose significant health risks if inhaled. When carbon monoxide is inhaled, it enters the blood and binds with haemoglobin, dropping the amount of oxygen that can be carried by the blood.
The major risks of exposure to carbon monoxide in the air include:

- *Carbon monoxide poisoning:* This is the most common and dangerous risk associated with carbon monoxide exposure. Indications of carbon monoxide poisoning include headache, dizziness, nausea, vomiting, misperception, and loss of consciousness. In severe cases, exposure to high levels of carbon monoxide can lead to coma or death.
- *Cardiovascular effects*: Carbon monoxide exposure can cause damage to the cardiovascular system, leading to chest pain, shortness of breath, and an increased risk of heart attack.
- *Neurological effects*: Long-term exposure to low levels of carbon monoxide can cause neurological damage, leading to memory loss, difficulty concentrating, and impaired coordination.
- *Fetal effects*: Pregnant women who are exposed to carbon monoxide can experience a range of adverse effects on their fetuses, including low birth weight, developmental delays, and cognitive impairment.

It is important to take steps to minimize the risk of exposure to carbon monoxide, including regularly maintaining and inspecting fuel-burning appliances, installing carbon monoxide detectors in homes and workplaces, and avoiding using portable fuel-burning equipment indoors. In the existing system, there is a technique or method to detect carbon monoxide

from the air. For this purpose, they have to develop a united system that consists of two sections.

The first section is the sensor for the carbon monoxide recognition area and the subsequent segment is the precise room segment. The figure beneath then shows the general block graph of the current framework.

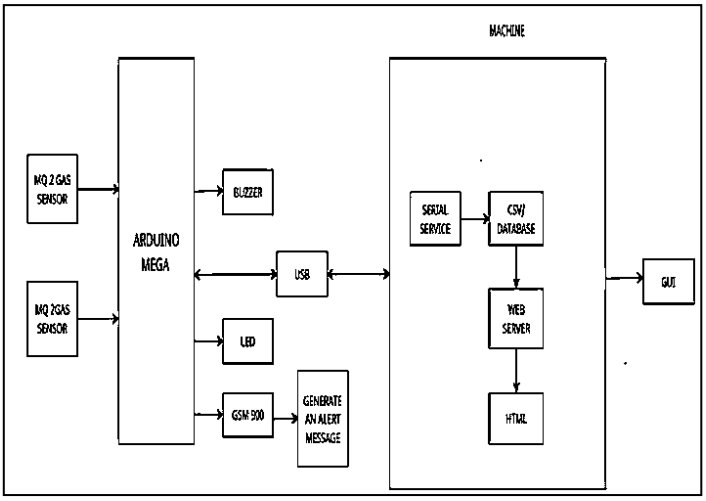

Fig 3: Block diagram.

The general block chart comprises gas sensors which is the MQ2 Gas Sensor. Those two gas sensors will accumulate the information from the adjoining climate and the gathered information will then be moved to the Arduino Mega to be perused and deciphered which will choose the following strategy to be taken. The Arduino Mega is likewise associated with a GSM 900 which assists with giving out messages or calls to caution clients in the event of an addition of carbon monoxide gas. The GSM 900 is compelling particularly when Wi-Fi is down. It gives a correspondence network that then permits two-way correspondence between the framework and the client or some other party included. The efficiency of the framework will be a ringer and driven. Those two are dynamic parts as they help as a perceptible caution as well as a visual alert to mindful the client to clear the region. The expansion of visual caution is vital to help an individual who has weakened hearing. At the point when the recognized convergence of carbon monoxide is high and is at perilous levels, the signal and drive will be initiated and hence will make the client aware of exit.

Arduino Mega is utilized as there are a considerable number of gadgets alongside sensors that are utilized in this framework thus the similarity of the sensors alongside the accessibility of the libraries accessible in Arduino makes it simpler to utilize Arduino. A PC or even a Raspberry Pi can be utilized as a machine. What's more, this machine is associated with the Arduino Mega by a USB. Inside this, a help chronic likewise usually known as the py sequential is a module for Python and it is utilized to send and get information from Arduino, consequently every one of the information that is from Arduino will be shipped off the py sequential. The information from the py sequential is then shipped off the comma-isolated values generally known as 'csv' or likewise the data set. Every one of the information from Arduino will be put away here inside the data set. Continuing on the information is then

shipped off Carafe which is a miniature web server. Essentially, it is a web server and subsequently, the information will be shipped off the web server. From that point, Flagon will create a HTML which will send the client to the site page to then have the option to screen and mind the groupings of the Carbon Monoxide inside the web server, the GUI is produced which then, at that point, will be refreshed each time it gets new information as it is requiring in genuine investment information which will assist the clients with checking the centralization of the Carbon Monoxide better [1].

III. PROPOSED SYSTEM

In the existing system, there is a method for how to detect the carbon monoxide levels in the air but there is no solution for how to destroy it or how to change its state into another harmless gas. So, we proposed a new innovative method by using this methodology we can either destroy carbon monoxide or change its state into another harmless gas. The proposed methodology mainly has two stages. In the first stage, we can observe or detect the carbon monoxide levels in the air, In the second stage we can either destroy or change its state into another harmless gas.

(A). Detect or observe carbon monoxide

Observing carbon monoxide in the air typically requires specialized equipment such as gas analyzers or detectors. These devices can measure the absorption of carbon monoxide in the air, often in parts per million (ppm) or parts per billion (ppb). If you are looking to monitor carbon monoxide levels in your home or workplace, you can purchase a carbon monoxide sensor, which is considered to aware you when carbon monoxide stages become dangerous. These detectors are widely available and can be purchased at most hardware stores or online retailers. It is important to note that carbon monoxide is a colour-less, odourless gas, so it cannot be spotted by ability to see or perfume. Regularly monitoring carbon monoxide levels and taking appropriate safety measures can help prevent exposure to this toxic gas.

(B). Absorb or Destroy carbon monoxide

There are chemicals that can absorb carbon monoxide (CO) from the air. One such chemical is potassium permanganate, which is often used in gas masks and other respiratory protective equipment. When exposed to carbon monoxide, potassium permanganate undergoes a chemical reaction that converts the CO into carbon dioxide (CO2) and water (H2O). Another chemical that can absorb carbon monoxide is started carbon. Triggered carbon is a extremely absorbent material that can adsorb a wide variety of gases and vapours, including CO. When the activated carbon is exposed to CO, the CO molecules are trapped within the pores of the material. Other chemicals that can absorb carbon monoxide include iron oxide and copper oxide. These materials can be used in catalytic converters in automobiles to convert CO into less harmful gases such as CO_2 and nitrogen oxides (NOx).

It's worth noting that while these chemicals can absorb carbon monoxide, they are not always effective at removing it completely from the air. The efficiency of these chemicals be contingent on a variation of aspects, including the concentration of CO in the air, the humidity and temperature of the environment, and the type and amount of absorbent material used. To destroy carbon monoxide (CO) from the air, it is usually necessary to convert it into other, less harmful substances. There are several ways to do this:

Catalytic converters: Catalytic converters are often used in automobiles to convert carbon monoxide, as well as other harmful gases, into less harmful substances like carbon dioxide and water. The converter uses a catalyst, typically made of precious metals like platinum or palladium, to initiate a chemical reaction that converts the CO into CO_2.

Thermal oxidation: In thermal oxidation, the air containing carbon monoxide is heated to a high temperature (typically between 600-900°C) in the presence of oxygen. This causes the CO to react with the oxygen and burn, forming CO_2. This process is often used in industrial settings to treat waste gases.

Biological treatment: Some bacteria and fungi can break down carbon monoxide into carbon dioxide and other harmless substances. This process is called biodegradation and can be used to treat air contaminated with carbon monoxide.

Chemical absorption: As mentioned earlier, certain chemicals like potassium permanganate, activated carbon, iron oxide, and copper oxide can absorb carbon monoxide. When these chemicals absorb the CO, they undergo a chemical reaction that converts it into other, less harmful substances.

It's imperative to communicate that the effectiveness of these methods will be contingent on several factors, including the concentration of CO in the air, the temperature and humidity of the environment, and the specific method used.

There are several different ways to detect carbon monoxide and destroy it or convert it into another form. but, in our proposed work we have to convert carbon monoxide into useful oxygen in three different stages. In the first stage, we have to detect carbon monoxide levels by using a co-sensor using the IOT concept. In the second stage convert carbon monoxide into carbon dioxide. In the third stage convert carbon dioxide into oxygen.

Stage 1: To detect carbon monoxide (CO) levels using an IOT (Internet of Things) device equipped with a CO sensor, you'll need the following components and steps:

Components:

- *CO Sensor:* Choose a CO sensor that is compatible with IOT platforms and provides accurate readings.
- *Microcontroller*: Select a microcontroller board that supports IOT connectivity, such as Arduino, Raspberry Pi, or a specialized IOT development board.
- *IoT Connectivity*: Use a wireless module or shield that enables your microcontroller to connect to the internet, such as Wi-Fi, Bluetooth, or cellular.
- *Power Supply*: Provide a stable power source to the microcontroller and CO sensor, considering the requirements of each component.
- *IOT Platform*: Choose an IOT platform to receive and process the CO sensor data, such as AWS IOT, Azure IOT, Google Cloud IOT, or a custom solution.

Steps:

Step1: Connect the CO Sensor

Connect the CO sensor to the appropriate pins on the microcontroller board according to the sensor's specifications. This usually involves connecting power, ground, and sensor output pins.

Step2: Set up the Microcontroller

Set up your microcontroller board with the necessary firmware or software. This typically involves writing code that initializes the sensor, reads data from it, and sends the data to the IOT platform.

Step3: Connect to the IOT Platform

Configure the IOT connectivity on your microcontroller to establish a connection with the chosen IOT platform. This may involve setting up Wi-Fi credentials, API keys, or certificates depending on the platform.

Step4: Sensor Readings and Data Transmission

Develop the logic on the microcontroller to periodically read CO sensor values. You can use the sensor's analog or digital output, depending on the type of sensor used. Convert the readings to appropriate units (e.g., parts per million - ppm) if necessary. Transmit the sensor data to the IOT platform using the established connection.

Step5: Data Processing and Visualization

On the IOT platform, set up data ingestion and processing pipelines to receive the CO sensor data. Depending on your requirements, you can perform data analytics, store the data, trigger alerts for high CO levels, or visualize the data in a dashboard.

Step6: Monitoring and Notifications

Implement monitoring mechanisms on the IOT platform to continuously monitor CO levels. we can set thresholds for safe levels and configure notifications (e.g., email, SMS) to alert users or trigger actions if the CO levels exceed those thresholds. Remember to follow safety guidelines when working with CO sensors, as they detect a potentially dangerous gas. Place the sensor in an appropriate location to ensure accurate readings and consider calibrating the sensor periodically for optimal performance.

Stage 2: In stage 2 carbon monoxide (CO) can be converted into carbon dioxide (CO_2) through a process called oxidation. The most common method involves the use of a catalyst, such as a platinum or palladium catalyst, which facilitates the reaction. Here's a general procedure to translate from carbon monoxide into carbon dioxide:

- *Ensure safety:* Carbon monoxide is a toxic gas, so make sure you're working in a well-ventilated area or under appropriate safety measures.
- *Choose an appropriate catalyst:* Select a suitable catalyst for the conversion, such as platinum or palladium. These catalysts are commonly used due to their ability to promote the oxidation reaction.
- *Set up the reaction:* Create a reaction chamber or use a suitable apparatus to contain the carbon monoxide and catalyst. Ensure proper gas flow control and temperature regulation.
- *Provide an oxidizing agent:* Introduce an oxidizing agent, such as air or oxygen, into the reaction chamber. The presence of oxygen is necessary for the translation of carbon monoxide into carbon dioxide.
- *Apply heat:* Heat the reaction chamber to an appropriate temperature range. The optimal temperature for the conversion typically lies between 150 to 300 degrees Celsius, depending on the catalyst used. Higher temperatures generally result in faster reaction rates.

- *Monitor the reaction:* Continuously monitor the reaction conditions, including temperature, gas flow rates, and the progress of the reaction. You can use analytical instruments such as gas chromatographs or infrared analyzers to analyze the gas composition.
- *Collect and dispose of the products:* After the conversion is complete, collect the resulting carbon dioxide gas and safely dispose of any remaining carbon monoxide or other reaction byproducts according to appropriate regulations.

It's important to note that the process described above is a generalized approach, and the specific conditions and catalyst choice may vary depending on the scale and requirements of the reaction. If you are planning to carry out this process on an industrial scale or in a specific context, it's advisable to consult specialized literature, industry guidelines, or experts in the field to ensure proper safety and efficiency.

Stage 3: In stage 3 converting carbon dioxide (CO_2) into oxygen (O_2) is not a straightforward chemical reaction. In nature, oxygen is produced from carbon dioxide through the process of photosynthesis, which occurs in plants and some microorganisms. Photosynthesis involves the absorption of sunlight, carbon dioxide, and water to produce oxygen and glucose.

Way to artificially convert carbon dioxide into oxygen, it's not a simple task and typically requires advanced technologies. One such technology is electrolysis, specifically a process called electrolysis of water, which can indirectly produce oxygen from carbon dioxide. Here's a general overview of the process:

- *Set up an electrolysis system:* Create an electrolysis cell with two electrodes, a cathode (negative electrode) and an anode (positive electrode). The electrodes are typically made of inert materials like platinum or graphite. Prepare an electrolyte solution: Fill the electrolysis cell with an electrolyte solution, usually a dilute solution of sulfuric acid (H_2SO_4) or sodium hydroxide (NaOH). The electrolyte helps facilitate the movement of ions within the cell. Connect a power source: Connect a power source, such as a battery or DC power supply, to the electrodes. The positive terminal should be connected to the anode and the negative terminal to the cathode.
- *Electrolysis process:* As the electric current flows through the cell, water molecules (H2O) at the cathode will be reduced, producing hydrogen gas (H2). At the anode, the water molecules will be oxidized, resulting in the release of oxygen gas (O2).
- *The overall reaction at the anode:* $2H_2O \rightarrow O2 + 4H^+ + 4e^-$
- *The overall reaction at the cathode*: $4H^+ + 4e^- \rightarrow 2H_2$
- *Collect and separate the gases*: The oxygen gas will be generated at the anode. Collect the oxygen gas separately from the hydrogen gas produced at the cathode. This can be done by using appropriate gas collection methods or by separating the gases through other means, such as membranes or absorption techniques.

It's important to note that the above process requires a significant amount of energy input, as electrolysis is an energy-intensive process. Additionally, this method only provides an indirect means of converting carbon dioxide into oxygen by producing hydrogen gas, which can then be used to generate oxygen through combustion or other methods.

In practical terms, it is much more efficient and environmentally friendly to focus on reducing carbon dioxide emissions and promoting the preservation of natural systems, such

as forests and marine ecosystems, that naturally produce oxygen through photosynthesis. Finally, by following the above procedure we implement a new system that can affix to drones and these drones are continuously (24x7) monitoring the pollutant areas and protecting the environment.

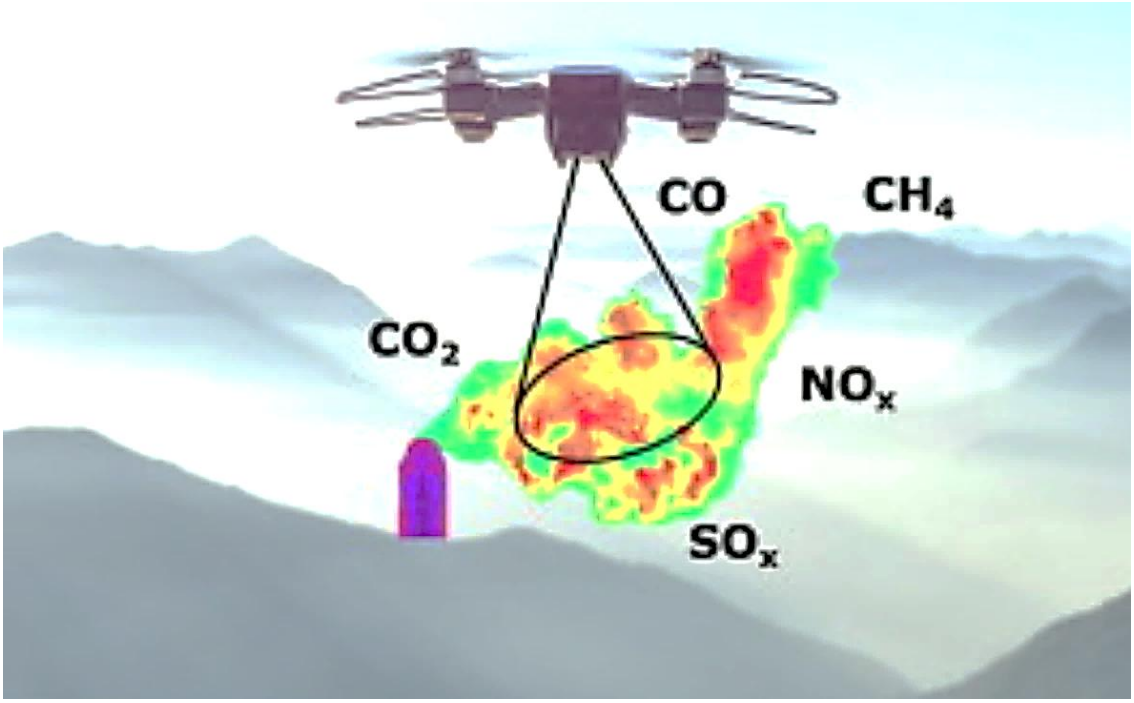

Fig 4: Proposed System

IV. CONCLUSION AND FUTURE ENHANCEMENT

In our proposed system we have to develop it to detect carbon monoxide levels in the polluted areas and convert it into another useful molecule like oxygen. We hope in the present situation it is very useful for us to protect ourselves from harmful gases. And also, it is very useful to protect our environment. We hope in the future we will also enhance this system to remove harmful molecules like Chlorine, Hydrogen sulfide, Ammonia, Sulfur dioxide, Nitrogen dioxide, Formaldehyde and Ozone.

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