5.9. Air quality sensor

An **air quality sensor** detects and measures pollutants, gases, and particulate matter (PM) in the air. These sensors are crucial for monitoring environmental and indoor air conditions for health and safety.

Types of Air Quality Sensors

Air quality sensors can be categorized by **what they measure**:

Sensor Type	What It Detects	Example Pollutants
Gas Sensors	Harmful gases	CO_2, CO, O_3, SO_2, NOx, VOCs
Particulate Matter (PM) Sensors	Airborne particles	PM1.0, PM2.5, PM10 (dust, smoke)
CO_2 Sensors	Carbon dioxide levels	Indoor air quality, ventilation
CO Sensors	Carbon monoxide	Toxic gas from combustion
Ozone (O_3) Sensors	Ozone concentration	Industrial areas, smog
VOC Sensors	Volatile organic compounds	Paint fumes, cleaning agents
Humidity & Temp Sensors	Relative humidity and temperature	Affect air quality & comfort

Applications of Air Quality Sensors

Air quality sensors are used in various industries and settings to promote health, safety, and efficiency.

Sector/Field	Applications
☐ **Smart Homes**	Monitor indoor air quality, trigger ventilation
☐ **Industry**	Emission monitoring, worker safety
☐ **Schools/Offices**	Air quality optimization for better productivity
☐ **Healthcare**	Cleanroom management, patient safety
☐ **Smart Cities**	Urban pollution mapping, traffic emissions
☐ **Automotive**	Cabin air monitoring, air filters control
☐ **Agriculture**	Greenhouse gas control, crop health monitoring
☐ **Research & Labs**	Environmental studies, chemical experiments

MQ135 Air Quality Sensor

It is a semiconductor air quality check sensor suitable for monitoring applications of air quality. It is highly sensitive to NH3, NOx, CO2, benzene, smoke, and other dangerous gases in the atmosphere. It is available at a low cost for harmful gas detection and monitoring applications.

5.10. CO2 sensor

A carbon dioxide sensor detects and measures the concentration of carbon dioxide (CO_2) in the air

There are **3 main types** of CO_2 sensors, based on the **detection technology** they use:

Sensor Type	How It Works	Pros	Common Use
NDIR (Non-Dispersive Infrared)	Measures how much infrared light CO_2 absorbs	High accuracy, stable, long life	HVAC, IAQ
Chemical (MOX)	CO_2 reacts with a chemical compound; resistance changes	Low cost, compact	Consumer devices
Photoacoustic	Measures sound produced by CO_2 absorbing light	Very precise, suitable for small sensors	High-end monitoring

Applications of CO_2 Sensors

Field/Industry	Application Examples
☐ **Building Automation**	Control HVAC systems for ventilation and energy efficiency
☐ **Smart Homes**	Monitor indoor air quality, automate air purifiers
☐ **Schools & Offices**	Ensure proper ventilation to boost health & focus
☐ **Healthcare**	ICU monitoring, breathing analyzers
☐ **Greenhouses**	CO_2 level control to optimize plant growth
☐ **Aviation & Automotive**	Cabin CO_2 level monitoring for safety
☐ **Industrial Safety**	CO_2 leak detection in breweries, cold storage, labs
☐ **Research Labs**	Atmospheric studies, controlled experiments

What is a Carbon Dioxide Sensor?

CO2 sensor definition is, an instrument that is used to detect the CO2 gas content in the air or its surroundings is known as a carbon dioxide sensor. Once the instrument detects the CO2 gas content then it generates an alarm so that appropriate action can be taken by the people.


CO2 Gas Sensor

This type of sensor plays an essential role in making a good atmospheric situation for the public. The application areas of CO2 sensors mainly include different industries like carbonated beverage beer, coal, agricultural planting, agricultural breeding & the daily life of people.

Working Principle

The CO2 sensor working principle is similar to infrared hydrocarbon detectors. They generate an infrared light beam tuned to an exact frequency that is absorbed readily through CO2 molecules. The main difference between the CO2 sensor and IR hydrocarbon detector is the selection of IR wavelength & filter.

Since every CO2 molecule is absorbed by some of the infrared light, the quantity of absorption is proportional to the CO2 percentage available within the ambient air. These CO2 sensors utilize sapphire windows to guard the elements of the infrared transmitter & receiver from injury from any acidic gases that may be present in the ambient atmosphere.
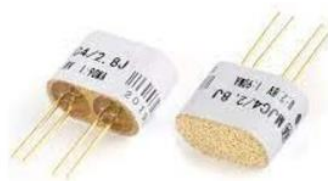
Catalytic Combustion Sensor

5.11. RFID Sensor

A Radio Frequency Identification (RFID) sensor **uses** radio waves **to** read/write data from RFID tags without physical contact.

Types of RFID Systems (Based on Frequency)

Frequency Range	Type	Read Range	Features	Common Tags
Low Frequency (LF)	~125–134 kHz	Up to 10 cm	Good for metal/liquid environments	Animal ID, access cards
High Frequency (HF)	13.56 MHz	Up to 1 meter	Common, cost-effective	NFC, library tags
Ultra-High Frequency (UHF)	860–960 MHz	Up to 12 meters	Long-range, fast data transfer	Inventory, supply chain
Microwave RFID	2.45 GHz	Up to 10+ meters	High-speed, sensitive to interference	Toll systems, active tags

Applications of RFID Sensors

Industry	Applications
☐ **Retail**	Inventory management, anti-theft systems
☐ **Access Control**	Employee ID badges, secure entry systems
☐ **Logistics**	Package tracking, warehouse automation
☐ **Healthcare**	Patient ID wristbands, medical equipment tracking
☐ **Transportation**	Toll collection (e.g., EZ Pass), fleet management
☐ **Libraries**	Book checkout/return automation
☐ **Agriculture**	Animal tagging, livestock health tracking
☐ **Manufacturing**	Asset tracking, production line monitoring
☐ **Airports**	Baggage handling systems