Port Connections in Detailed Tables
Machine learning-Enhanced Portable Gas Detection System for Mines
By - Shivam Chaturvedi

1. Gas Sensors Connections

Sensor	ESP32 Pin	Purpose	Details
MQ135 (Gas Sensor)	A0	Detects air quality (e.g., CO2, NH3, etc.).	Provides analog voltage output based on gas concentration.
MQ7 (CO Sensor)	A1	Measures carbon monoxide levels.	Outputs voltage proportional to CO levels.
MQ2 (Smoke Sensor)	A2	Detects smoke and flammable gases.	Indicates presence of combustible substances.
TGS2600 (Air Quality Sensor)	A3	Monitors air pollution (e.g., H2, CO).	Outputs analog signal for gas concentration.
TGS822 (Alcohol Sensor)	A4	Detects alcohol and hydrocarbons in the air.	Analog signal correlates with gas levels.

2. Environmental Sensors Connections

Sensor	ESP32 Pin	Purpose	Details
BME280 (Temp, Hum, Pressure)	I2C (SDA: D21, SCL: D22)	Measures temperature, humidity, and pressure.	Shares I2C lines with other devices.
BH1750 (Light Sensor)	I2C (SDA: D21, SCL: D22)	Detects ambient light intensity.	Requires unique I2C address.

3. Indicators and Actuators

Device	ESP32 Pin	Purpose	Details
Green LED	GPIO12	Indicates safe gas levels.	Turns on when all gases are within safe limits.
Yellow LED	GPIO13	Indicates moderate gas levels.	Activates for cautionary situations.
Red LED	GPIO14	Indicates hazardous gas levels.	Lights up during critical situations.
Piezo Buzzer	GPIO25	Emits an audible alert during hazards.	Activates alongside red LED.
Exhaust Fan (Relay)	GPIO26	Removes harmful gases during critical levels.	Controlled by relay module.

4. Communication and Logging

Device	ESP32 Pin	Purpose	Details
LoRa Module	SPI (MOSI: D23, MISO: D19, SCK: D18, NSS: D5)	Sends data to the main office via LoRa network.	Requires SPI communication protocol.
Micro SD Card	SPI (CS: D4, MOSI: D23, MISO: D19, SCK: D18)	Logs real-time sensor data for future analysis.	Shares SPI lines with LoRa module.
Wi-Fi (Built-in)	ESP32 Internal Module	Sends alerts to nearby personnel over Wi-Fi.	Utilizes the ESP32's onboard Wi-Fi capabilities.

5. Display Module

Device	ESP32 Pin	Purpose	Details
OLED Display (2.42")	I2C (SDA: D21, SCL: D22)	Displays real-time sensor data and gas levels.	Shares I2C lines with BME280 and BH1750.

6. Power Supply

Component	Details
Battery	3.7V Li-ion battery with rechargeable capability.
Buck Converter	Regulates voltage to power the ESP32 and sensors.
Common Ground	All components share a common ground with the ESP32.