Air Polluted: Ammonia and Co2 Measurement By Using Arduino

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***Abstract*—In this research, the measuring of air quality is one of the needs of humans and other living organisms anywhere. And the detection of the amount of gases that pollute the air such as ammonia and carbon dioxide gases in animal farms or poultry fields or chemical and biological laboratories, which must be detected and reduce their levels in those places or it will cause fatal problems or risk their lives, and it will be dangerous for the health of workers and animals as well, in this research, the design, implementation and control of air quality and measurement of species dimensions Selected gases such as ammonia, carbon dioxide, moisture and air quality (which contains of four different dangerous gases) in one device using ARDUINO. The design consider three deferent channels separately can monitor remotely using IOT (Internet of Things) principles, and it will provide more security for workers and technicians, and run the ventilation system to reduced that amount of gases. The decision is dangers or good (safe) is depend on international scientific references level and make comparison with real and instantaneous gas measurement then showing the result on the screen . The results was recoded with deferent condition to evaluate the system.**

***Keywords*— air pollution, air quality measurement, Ammonia Gas, Arduino, Carbon Dioxide gases.**

I. INTRODUCTION

The Internet of Things is a way to connect to and communicate with many different components online. Each of them may be recognized independently and combined into one by an embedded computer system. A vast, multipurpose network that operates on a global scale. The detection of ammonia gas leaks using a monitoring system and an ammonia gas sensor is implemented in this study utilizing the Internet of Things idea (MQ137). The Ammonia Gas Sensor (MQ137) finds significant concentrations of ammonia gas in labs, businesses, factories, hospitals, etc. High concentrations of ammonia gas can result in mortality, lung damage, or blindness. When the ammonia gas concentration surpasses the MQ137 sensor's programmed threshold, the ammonia gas sensor buzzes and calls the police. The system's operating principle of electrochemistry. Electrochemical sensors keep track of the biased pressure of gases under ambient conditions. The liquid electrolyte in the sensor is used to monitor and diffuse ambient air with the aid of a membrane [1]. In order to determine the amount of ammonia in the air, a gas monitoring device is used in the laboratory and processed and reported via the Internet of Things. Ammonia is a significant man-made chemical as well as a naturally occurring chemical in the atmosphere. It has the chemical symbol NH3 and is described by that. This kind of ammonia is also known as anhydrous (or "waterless") ammonia or ammonia gas. When ammonia is at room temperature, it is a colorless gas that is lighter than air and has a strong stench. Ammonia transforms into a liquid at minus 28 degrees Fahrenheit (-33 degrees Celsius). Ammonia is easily dissolved in water. When in this condition, it is sometimes referred to as liquid ammonia, ammonia water, or ammonia solution. The ammonium ion NH4+ is formed when the bulk of the ammonia in water is converted. Ammonia is a crucial component for the existence of plant, animal, and human life. It may be found in water, soil, and the air and is an essential supply of nitrogen for plants and animals [2]. Ammonia in the environment is mostly produced by the naturally occurring decomposition of dead plants and animals, or manure. Ammonia may be found in a variety of areas, including manure, power plants, mobile sources, and other industry pollutants. Due to their wide range of applications and pervasiveness in the environment, there are usually worries over their possible negative effects on human health. Carbon dioxide (CO2) is a colorless and odorless gas at atmospheric pressures. Usually non-flammable and non-toxic. Due to air displacement, it is heavier than air and may result in asphyxia. Dissolved in water. Identify the weak acid carbonic acid. The container may violently rupture and explode if exposed to heat or fire for an extended period of time. In addition to managing chemical processes and putting out fires, it is used to freeze food. A double bond connects each oxygen atom to the carbon atom in carbon dioxide, which is a one-carbon molecule with the formula CO2. Under normal circumstances, it is a colorless, odorless gasoline created at some point in the respiratory system by all animals, fungi, and microbes that depend immediately or indirectly on living or decomposing flora. As a solvent, vasodilator, anesthetic, antagonist, greenhouse gas component, human metabolite, food packaging gas, meal leavening agent, refrigerant, budding yeast metabolite, E. coli metabolite, and mouse metabolite, to name a few, it also performs these functions. They are carbon oxides, gaseous molecules, and compounds with one carbon. [2], [3].

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II. Source of Ammonia and accepted levels

A. Metabolism

Metabolism is the process through which chemical molecules transform into other chemical compounds in living things. Since all species can make and use ammonia, it is an essential commercial chemical. When you consume proteins and amino acids, it is produced. Ammonia is required for the synthesis of proteins and DNA, which are the fundamental components of life. In addition, additional food components are broken down by digestive system microbes to make ammonia. The circulatory system takes in around 4 grams of the daily ammonia production of the body, which is about 17 grams (0.5 ounces). The leftover material is eliminated by urine [4].

B. External Sources

Humans are exposed to ammonia externally on a daily basis in amounts of 18 milligrams (mg/day). While it comes to ingesting proteins and some foods that have ammonium salts added, as well as when being in close contact with the air, water, or skin, these are the main ways that people come into contact with ammonia from outside sources. Ammonia is used to stabilize, leaven, and improve food during food preparation. On a worldwide scale, the estimated average ammonia concentration in the environment ranges from 0.6 to three parts per billion (ppb). The fluctuations in air ammonia concentrations during various applications are influenced by geographical conditions, altitude, seasons, and man-made sports. Concentrations are often better in the Midwest than on the west or east coasts, with a national average of 3.3 ppb. In traditional major towns, an individual generally breathes in around 0.04 mg of ammonia daily, whereas the expected airborne ammonia level is about 0.03 ppm. A person normally takes zero.1 mg per day in rural settings. The kind of soil, temperature, and ambient PH all have an impact on the ammonia levels in water, which also vary seasonally, regionally, and over time. Human daily water consumption in cities is often around 1 mg, compared to less than 0.04 mg in nation-states. Smokers' breath contains an extra 0.8 mg of ammonia daily, based on 20 cigarettes smoked per day [5].

C. Ammonia Health effects

In order to determine how exposure to ammonia might affect human fitness, laboratory studies and statements from humans exposed to the gas have been used to assess changes in various organs, declines in lung characteristics, changes in cilia beating inside the trachea, effects on nerve conditions, and the ability to fight bacterial lung infections. Carcinogenicity, mutagenicity (damage to the genetic makeup of cells), and injury to the reproductive system or fetus have also been studied. The sections that follow go over the key findings regarding ammonia that have been drawn from numerous studies on both humans and animals that have been carried out by the WHO, the Corporation for Toxic Substances and Disorder Registry (ATSDR), the Environmental Protection Agency, the Occupational Protection and Health Administration, the American Conference of Commercial Hygienists (ACGIH), and TFI. Rapid progress in fitness Ammonia, in both its gaseous and liquid forms, can irritate the skin, eyes, and respiratory system as a result of its alkaline nature. Ammonia has biological impacts on people when they are exposed to it in acute doses; these effects depend on the ambient concentration, how much is ingested by the body, and how long the exposure lasts. Ammonia levels as low as 5 ppm can be detected by smell in the air. The typical person can detect the smell of ammonia at a concentration of around 17 ppm. The majority of people can detect ammonia in water at roughly 35 ppm [7]. The ACGIH recommends a Threshold Limit Value (TLV) of 35 ppm as a short-term publicity limit (STEL) and 25 ppm as a time-common exposure level (TCEL) to avoid ocular, nose, and throat irritation (TWA). The ACGIH develops TLVs as suggestions to assist in handling issues with occupational fitness. TLVs may no longer be lawful and serve no function for prisoners, although being commonly recognized as guidelines [7]. It is also necessary to establish specific applicable exposure limits with the assistance of certain states and other organizations that have established various standards for ammonia exposure limits for situations like public health evaluation and emergency response. The lowest concentration of ammonia that has been discovered to irritate the eyes, nostrils, and throats of the most sensitive persons is 50 ppm, according to OSHA. Without personal protective equipment (PPE), the maximum airborne concentrations are lower than those that are deemed acceptable for everyone to be exposed to for up to an hour without experiencing or developing adverse effects. Extreme fitness ramifications, irreversible motions, or symptoms that might make it challenging for someone to take preventative action At 100 ppm, something happens. The majority of airborne concentrations without a shielding device are below the level at which it is believed that practically everyone may be exposed for up to 30 minutes without developing or experiencing health consequences that could jeopardize their way of life. A concentration of 500 ppm is deemed fatal. In addition to coughing, bronchospasm, and chest discomfort, inhaling between 700 and 1700 ppm might result in significant eye infection, tears, and other symptoms. Ammonia concentrations more than 5000 ppm can result in chemical bronchitis, fluid buildup inside the lungs, chemical burns to the skin, and even death. Acute ammonia exposure isn't often associated with long-term lung damage, according to ATSDR statistics, unless exposure levels are exceptionally high and dangerously near to death [5], [7].

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TABLE I
EFFECTS OF AMMONIA EXPOSURE FOR A FEW MINUTES WITHOUT PROTECTIVE EQUIPMENT

Concentration (ppm)	Symptoms	Sign	Consequences
Less than 5000	Having a cough, hoarseness, throat tightness, and singing in the mouth and eyes	Reddening of the tongue, lips, mouth, and conjunctiva, as well as eyelid swelling and throat edema	typically without pulmonary problems during recovery
5000 -10000	Exaggeration of the aforementioned symptoms, tightness in the chest, trouble swallowing, hoarseness, and a cough that occasionally produces blood	Distress, an increase in heart rate and breathing, swollen eyes, and mucous membrane burning	deaths caused by airway blockage
Greater than 10000	Similar to the aforementioned symptoms, a chronic cough that produces a lot of foamy sputum	shock, agitation, anxiety, and a quick pure volume pulse cyanosis and respiratory issues	Asphyxiation-related death: complications may cause subsequent deaths for survivors

III. SOURCE OF CO2 GAS

The true problem with indoor CO2 levels is your body, not the environment. Your body takes in oxygen by breathing while exhaling carbon dioxide. The amount of CO2 in the enclosed space rises as a result of this released gas. Smoking, using gas or wood stoves for cooking, and utilizing fireplaces are additional producers of CO2 in the space. In your home, any open fire emits CO2. In general, since carbon dioxide emissions are diluted by the surrounding air, you shouldn't be concerned about it when you're outside. However, the levels of CO2 there can rise to dangerously high levels if you are in a region that has been exposed to fire or combustion, whether it be natural or artificial. 2.4 CO2's impact on health Since CO2 is non-toxic, using it as fuel won't harm you. Given that carbon dioxide is a necessary component of the environment, this is an important fact to take into account. Nowadays, CO2, not oxygen, is the main component of human breathing mechanics. Without carbon dioxide, breathing is not possible. Only when CO2 is concentrated should you be worried. Simply said, when carbon dioxide levels rise in a small area, it takes the place of oxygen, which is what your body needs to survive. When your body doesn't get enough oxygen, it slows down and starts to malfunction. Your brain is most affected by carbon dioxide because it asphyxiates. There are noticeable changes on how you think at moderate CO2 levels, or approximately 1000 ppm. The same amounts also cause pain from inhaling stifling air and impair focus and attention. Overall, the moderate CO2 levels that are typical in classrooms, offices, and even your house may not allow your frame to function at its best. For tasks that call for better-stage inquiry, there may be a significant drop in cognitive function at better stages, about 2500 ppm. Humans have greater difficulties and fatigue. Although far less frequent, these circumstances can nevertheless occur often in inadequately ventilated buildings and campuses. Table II below is a study showing how CO2 affects your brain function [8].

TABLE II
EFFECTS OF AMMONIA EXPOSURE FOR A FEW MINUTES WITHOUT PROTECTIVE EQUIPMENT

CO_2 Concentration	Healthy Effects
Less 1000 ppm	No health effect or partial
1000 ppm to 2500 ppm	Fatigue, lack of attention, and an uneasy "stuffy" feeling in the air
2500 ppm to 5000	Headache, drowsiness, tiredness
5000 ppm to 40000	Violates OSHA requirement, severe headaches, and slight intoxication depending on the expose time.
40000 ppm to 100000 ppm	IDLH symptoms include lightheadedness, rapid heartbeat, sweating, difficulty breathing, convulsions, and loss of consciousness following prolonged exposure (immediate danger to life or health).
Greater 100000 ppm	Minutes-long unconsciousness, coma, and mortality risk

IV. SYSTEM DESIGN

This work was assumed 3 channels which measures the requirement for detecting Ammonia, CO2, and air quality, each channel will contain the following items:

1- Arduino unit.
2- Sensor
3- LCD display

The following fig (1) shown the connection between that items.

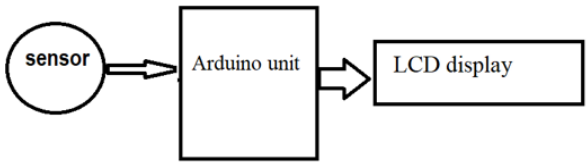

Fig. 1. *Channel design*

A. Ammonia Detection channel

The design of Ammonia Channel will connect the following items

1- Numerous electrical applications may make use of the open source, Arduino Uno, a low-cost, versatile, and easy-to-use microcontroller board. Figure 2 depicts the Arduino board, which can connect with the Raspberry Pi board, the Arduino shield, and other Arduino boards. Its output may control motors, servos, relays, and LEDs. The Arduino UNO has an Atmega328 AVR CPU, six analog input pins, six digital I/O pins, six PWM output pins, and a total of twelve pins.

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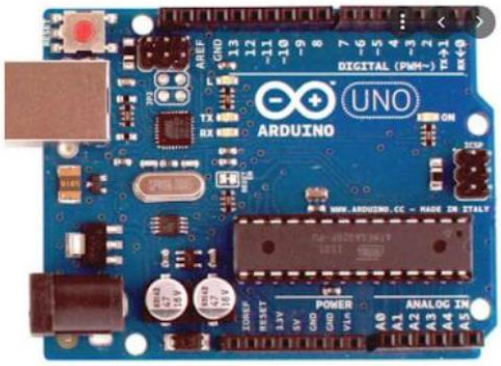

Fig. 2. *Arduino board*

2- MQ 137 Sensor with the following features
Model No. MQ137

- Semiconductor Sensor Type
- Bakelite Standard Encapsulation (Black Bakelite)
- Ammonia Detection Gas
- Concentration: 5-500ppm (Ammonia)

Fig. (3) Displays the MQ 137 Sensor.

Fig. 3. MQ_137 Sensor

3- LCD display

The Figure (4) shown the circuit diagram of the Ammonia channel [9].

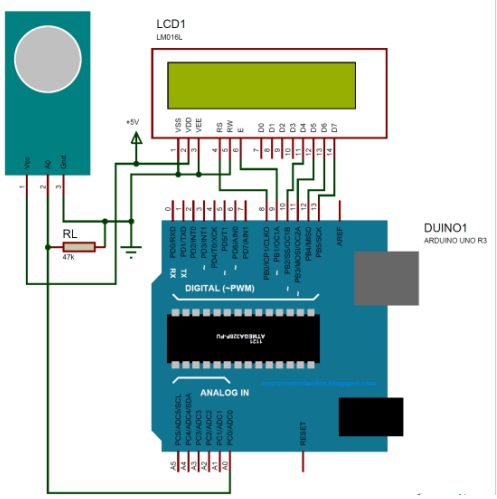

Fig. 4. circuit diagram of Ammonia channel

B. *CO2 Detection channel*

The design of CO2 Channel will connect the following items:

1- Arduino Uno unit.

2- MQ 811 Sensor having the following features The MG-811 sensor module is reliant on humidity and low temperatures, and is very sensitive to CO2 and less sensitive to alcohol and CO. The ideal temperature for the sensor to function at is provided by the inbuilt heating circuit. For the greatest thermal sensor performance, increase internal power to 6V. A built-in harmonic circuit amplifies the output signal of this sensor. The Gravity interface has been modified to support plug and play in order to make using this CO2 sensor easier. The CO2 sensor that attaches to your Arduino microcontroller works best with the Arduino IO expansion shield. This electrochemical CO2 sensor, which is based on Arduino, is appropriate for qualitative analysis. Other infrared CO2 sensors are capable of doing quantitative analysis. Figure (5) shows the MQ-811 CO2 sensor.

Fig. 5. MQ-811 CO2 sensor

3- LCD display

The Figure (6) shown the circuit diagram of the CO2 channel [9].

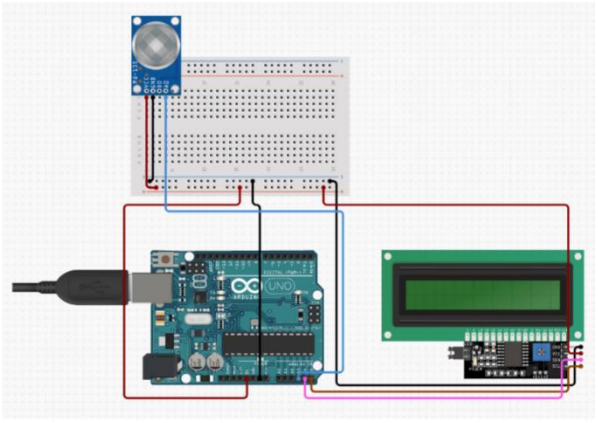

Fig. 6. the circuit diagram of the CO2 channel

C. *Air quality channel*

The design of Air quality Channel will connect the following items

1- Arduino Uno unit.

2- Air Quality Sensor Module MQ-135

The MQ135 air quality sensor module requires around 150mA and runs at 5V. Prior to producing reliable results, it needs to be heated up. The Figure (7) below shows the MQ-135 Air quality sensor module

3- LCD display

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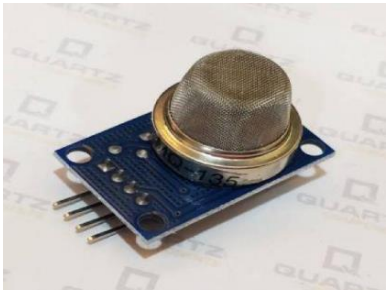

Fig. 7. MQ-135 Air quality

The Figure (8) shown the circuit diagram of the Air quality channel.

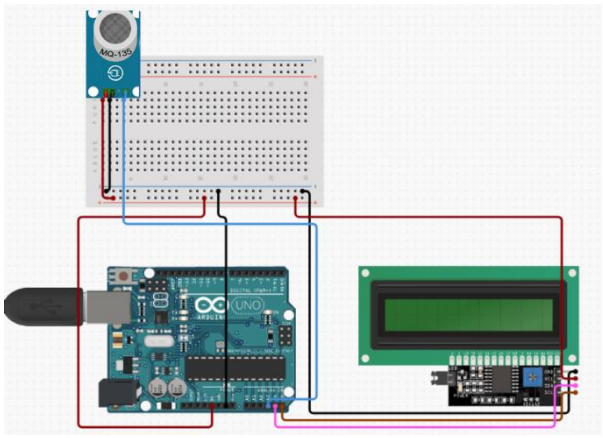

Fig. 8. the circuit diagram of the Air quality channel

D. Arduino Uno programming

MQ-1Arduino programming language (wire-based) and Arduino software (IDE), processor-based. The C++ programming language is used with the help of an Arduino emulator, and the following programming board is shown in Figure 9 [10].

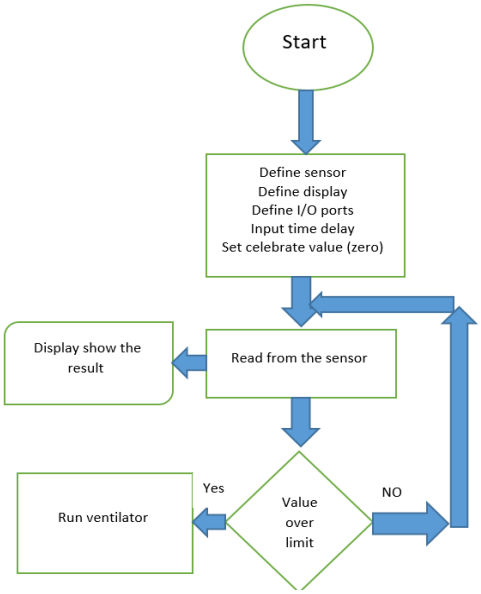

Fig. 9. The follow chart of programming

CONCLUSION

In this work, Ammonia, CO2, Air Quality Detector, an accurate system can be performed quickly to measure such gases to improve knowledge of the climate in closed areas, it can be used for educational purposes for undergraduate and graduate students, it can be used for analyzing and controlling places that are sensitive of gases such as pet farms, food safe houses, and hospitals, to monitor the amount of the dangerous gases and controlling the value of the gases by using any suitable techniques, , thus for the future work another type of natural gases can be included for this work . The Figure (10) shows all three channels measurement in three different areas.

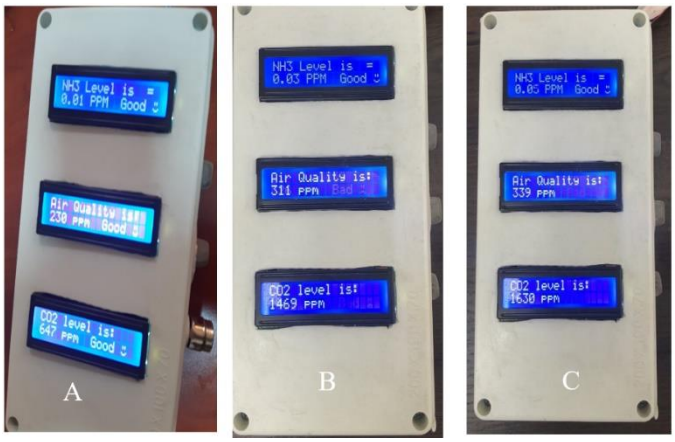

Fig. 10. all three channels measurement in three different areas. (a) Normal room, (b) crowded room, and (c) after using a perfume

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