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Monitoring And Assessment of Underground Hazardous Gases Using Electronic Sensors and Wireless Technology

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ABSTRACT- Monitoring and assessment of underground hazardous gases are necessary to identify potential hazards initiate remedial measures in advance by that otherwise would lead to disastrous conditions. In this project we will discuss the concept of real time monitoring in assessment of hazardous gases in typical underground mine using arduino and sensors. Typical ventilation of parameters including temperature, humidity and gas concentrations are monitored using sensors in the laboratory setting in various ranges and indices proposed by previous researchers for interpreting of fire gases and spontaneous combustion conditions are predicted from monitored data and transmitting and receiving of data using wireless technology. Data Spread sheets is used for displaying this information in real time monitoring systems and data storing that would help in creating a safe end comfortable working environment for personnel end equipment working Underground.

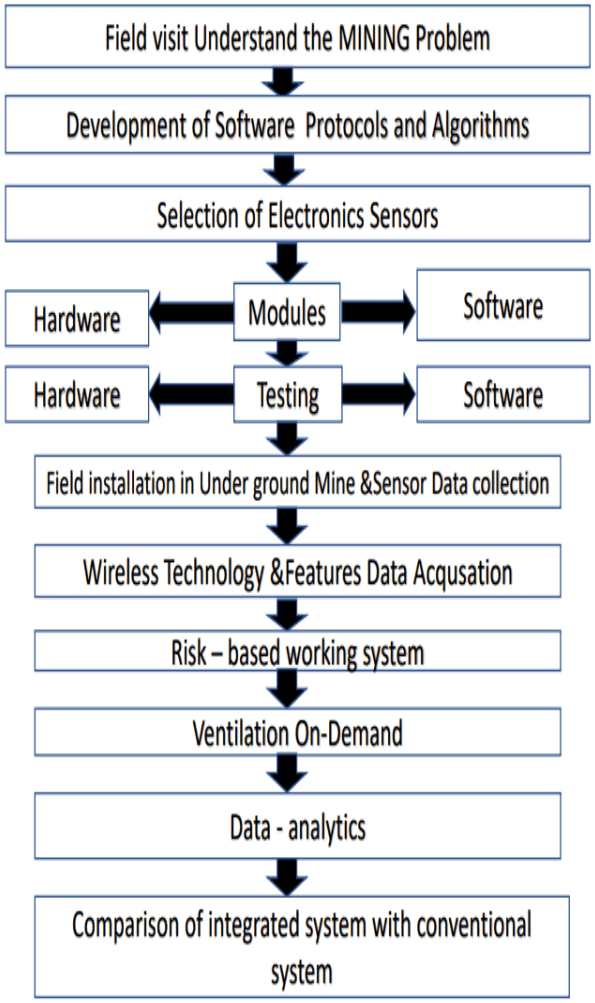
Keywords- Arduino Uno, Temperature Sensor, Connetions, Ultrasonic Sensor, Gas Sensors.

INTRODUCTION:

The underground mine environment has general challenges better to be dealt with for safe mining. These include noxious gases roof play Insane explosion . Among other hazards, fires and gas outbreaks are two catastrophic events that could lead to injures and fatalities the mine . Risks associated with confined areas require predictive analytics to prevent the development of such conditions that otherwise lead to would create disasters .Primarily underground mine involves

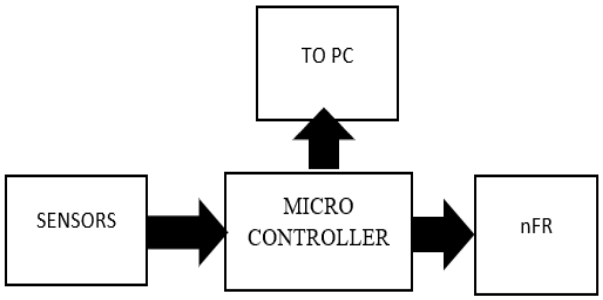
confined airways working miners, machinery and hazards that could come into effect under proper conditions. Atmospheric monitoring systems are positioned in underground airways to achieve constant monitoring of hazards including noxious gas out reached and fires . The main objective of the research study is to investigate the possibility establishing an atmospheric monitoring system for a block cave mine and migrate the effects of hazardous conditions though engineering controls.Atmospheric monitoring in Real- time helps in obtaining different characteristics of the mine atmosphere that would help in optimizing different characteristics of the mine atmosphere that would help in optimizing and operating the existing ventilation system effectively In this study basic atmospheric monitoring system, Arduino microcontroller with carbon monoxide and temperature humidity sensors was developed for a proof of concept.

METHODOLOGY

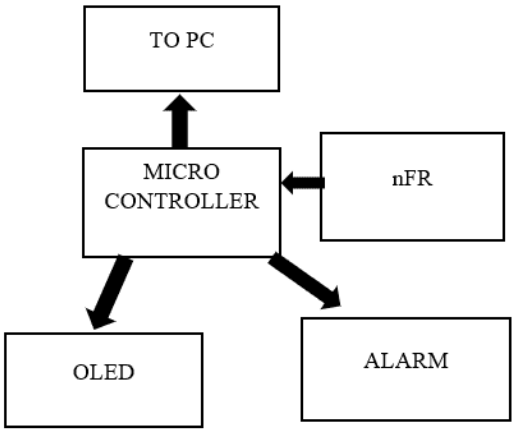


BLOCK DIAGRAM OF PROPOSED SYSTEM

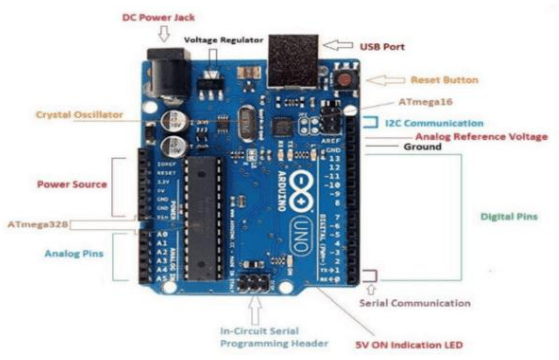
• TRANSMITTER



• RECEIVER



ARDUINO UNO



INTRODUCTION TO ARDUINO UNO

Arduino Uno is a microcontroller board, developed by Arduino.cc, based on the Atmega328 microcontroller and is marked as the first Arduino board developed(UNO means “one” in Italian). The software used for writing, compiling & uploading code to Arduino boards is called Arduino IDE (Integrated Development Environment), which is free to download from Arduino Official Site. It has an operating voltage of 5V while the input voltage may vary from 7V to 12V.

Arduino UNO has a maximum current rating of 40mA, so the load shouldn’t exceed this current rating or you may harm the board.

It comes with a crystal oscillator of 16MHz, which is its operating frequency.

Arduino Uno Pinout consists of 14 digital pins starting from D0 to D13.

It also has 6 analog pins starting from A0 to A5.

It also has 1 Reset Pin, which is used to reset the board programmatically. In order to reset the board, we need to make this pin LOW.

It also has 6 Power Pins, which provide different voltage levels.

Out of 14 digital pins, 6 pins are used for generating PWM pulses of 8-Bit resolution. PWM pins in Arduino UNO are D3, D5, D6, D9, D10 and D11.

Arduino UNO comes with 3 types of memories associated with it, named: • Flash Memory: 32KB • SRAM: 2KB • EEPROM: 1KB

Arduino UNO supports 3 types of communication protocols, used for interfacing with thirdparty peripherals, named:

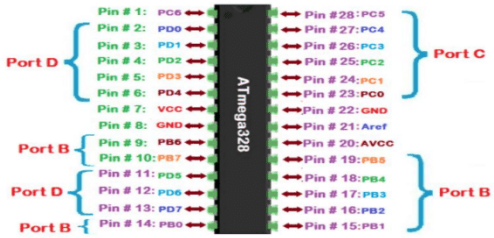
• Serial Protocol

• I2C Protocol

• SPI Protocol.

FEATURES OF ARDUINO UNO

A reset pin is present in the board that resets the whole board and takes the running program in the initial stage. This pin is useful when the board hangs up in the middle of the running program; pushing this pin will clear everything up in the program and starts the program right from the beginning. There are 14 I/O digital and 6 analog pins incorporated in the board that allows the external connection with any circuit with the board. These pins provide flexibility and ease of use to the external devices that can be connected through these pins. There is no hard and fast interface required to connect the devices to the board. Simply plug the external device into the pins of the board that are laid out on the board in the form of the header. The 6 analog pins are marked as A0 to A5 and come with a resolution of 10bits. These pins measure from 0 to 5V, however, they can be co nfigured to the high range using analog Reference() function and AREF pin. Only 5 V is required to turn the board on, which can be achieved directly using a USB port or external adopter, however, it can support an external power source up to 12 V which can be regulated and limit to 5 V or 3.3 V based on the requirement of the project.



Atmega328 Microcontroller

ARDUINO UNO PIN DESCRIPTION

There are several I/O digital and analog pins placed on the board which operates at 5V. These pins come with standard operating ratings ranging between 20mA to 40mA. Internal pull-up resistors are used in the board that limits the current exceeding the given operating conditions. However, too much increase in current makes these resisters useless and damages the device.

LED. Arduino Uno comes with a built-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it ON and LOW will turn it OFF.

Vin. It is the input voltage provided to the Arduino Board. It is different than 5 V supplied through a USB port. This pin is used to supply voltage. If a voltage is provided through a power jack, it can be accessed through this pin.

5V.This board comes with the ability to provide voltage regulation. 5V pin is used to provide output regulated voltage. The board is powered up

using three ways i.e. USB, Vin pin of the board or DC power jack.

USB supports voltage around 5V while Vin and Power Jack support a voltage ranges between 7V to 20V. It is recommended to operate the board on 5V. It is important to note that, if a voltage is supplied through 5V or 3.3V pins, they result in bypassing the voltage regulator that can damage the board if the voltage surpasses its limit.

GND.These are ground pins. More than one ground pins are provided on the board which can be used as per requirement.

Reset.This pin is incorporated on the board which resets the program running on the board. Instead of physical reset on the board, IDE comes with a feature of resetting the board through programming.

IOREF.This pin is very useful for providing voltage reference to the board. A shield is used to read the voltage across this pin which then selects the proper power source.

PWM. PWM is provided by 3,5,6,9,10, 11pins. These pins are configured to provided 8 Arduino UNO Pin Description -bit output PWM.

SPI. It is known as Serial Peripheral Interface. Four pins 10(SS), 11(MOSI), 12(MISO), 13(SCK) provide SPI communication with the help of the SPI library.

AREF. It is called Analog Reference. This pin is used for providing a reference voltage to the analog inputs.

TWI. It is called Two-wire Interface. TWI communication is accessed through Wire Library. A4 and A5 pins are used for this purpose.

Serial Communication. Serial communication is carried out through two pins called Pin 0 (Rx) and Pin 1 (Tx). Rx pin is used to receive data while Tx pin is used to transmit data.

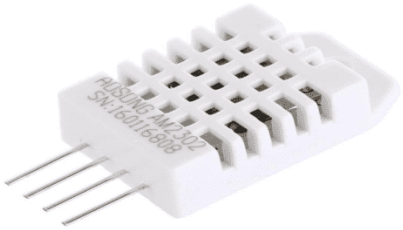
External Interrupts. Pin 2 and 3 are used for providing external interrupts. An interrupt is called by providing LOW or changing value.

SOFTWARE INSTALLATION

After learning about the main parts of the Arduino UNO board, we are ready to learn how to set up the Arduino IDE. Once we learn this, we will be ready to upload our program on the Arduino board. In this section, we will learn in easy steps, how to set up the Arduino IDE on our computer and prepare the board to receive the program via USB cable. Step 1 − First you must have your Arduino board (you can choose your favorite board) and a USB cable. In case you use Arduino UNO, Arduino Duemilanove, Nano, Arduino Mega 2560, or Diecimila, you will need a standard USB cable (A plug to B plug). In case you use Arduino Nano, you will need an A to Mini-B cable.

TEMPERATURE SENSOR

The DHT22 is a basic, low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old . Simply connect the first pin on the left to 3-5V power, the second pin to your data input pin, and the rightmost pin to ground. Although it uses a single wire to send data it is not Dallas One Wire compatible! If you want multiple sensors, each one must have its own data pin.



WORKING

Connect the first pin on the left to 3-5V power, the second pin to your data input pin and the right most pin to ground.

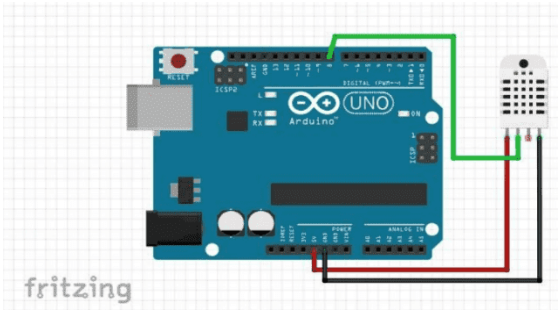
Note: Although it uses a single-wire to send data it is not Dallas One Wire compatible! If you want multiple sensors, each one must have its own data pin.

Standard AM2302/DHT22 AM2302/DHT22 with big case and wires

Digital relative humidity & temperature sensor AM2302/DHT22

MODEL	DHT22/AM2302
Power supply	3.3-6V DC
Output signal	Digital signal via 1-wire bus
Sensing element	Polymer capacitor
Operating range	Humidity 0-100%RH; Temperature -40~80Celsius
Accuracy	Humidity +-2%RH(Max +-5%RH); Temperature <+-0.5Celsius
Resolution or sensitivity	Humidity 0.1%RH; Temperature 0.1Celsius
Repeatability	Humidity +-1%RH; Temperature +-0.2Celsius
Humidity hysteresis	+-0.3%RH
Long-term stability	+-0.5%RH/year
Sensing period	Average: 2s
Interchangeability	Fully interchangeable
Dimensions	Small size 14185.5mm; Big size 22285mm

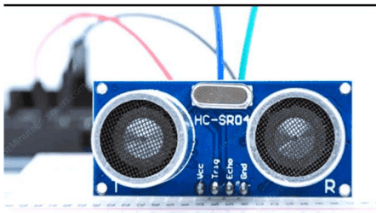
CONNETIONS DIAGRAM



Arduino pins	DHT sensor pins
5v	VCC
ground	ground
Pin 8	A0

ULTRASONIC SENSOR

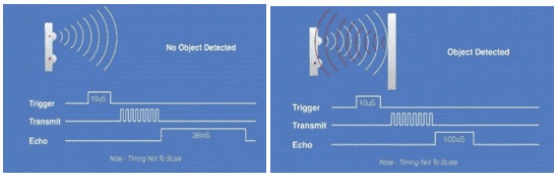
An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves . An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns.



WORKING

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducer to send a pulse and to receive the echo. The sensor determines the distance to a target by measuring time lapses between the sending and receiving of the

ultrasonic pulse. The working principle of this module is simple. It sends an ultrasonic pulse out at 40kHz which travels through the air and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated. Ultrasonic sensors are a great solution for the detection of clear objects. For liquid level measurement, applications that use infrared sensors, for instance, struggle with this particular use case because of target translucence . For presence detection, ultrasonic sensors detect objects regardless of the color, surface, or material (unless the material is very soft like wool, as it would absorb sound.) To detect transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.



CALCULATIONS OF DISTANCE

Ultrasonic signals travel at the speed of Sound. At 20°C the speed of sound is 343 m/s Time measured by HC-SR04 is for return trip. Divide time in half to calculate distance Δt=Time delay C =speed of sound D =Distance measured Speed of sound =343 m/s. As we are measuring in centimeters we will change units 343 meters per second is 0.0343.Centimeters per microsecond sound takes 29.157 micro seconds to travel one centimeter2.54 centimeters equals one inch if you need to convert result. There are 2 ways to calculate distance using echo pulse width.

CALCULATIONS

Method 1

D = (Δt/2)*C D = (500/2)*0.343

D = 250*0.0343

D = 8.575

Method 2

D = (Δt/2)/29.154

D = (500/2)/29.154

D = 8.8515 cm

D = 8.575/2.544 = 3.376 inches

CALCULATING THE SPEED OF SOUND IN AIR

At 0° and 0% humidity sound travels at 3311.4 m/s

Sound travels faster as temperature and humidity rise

C=331.4+(0.606*T)+(0.0124*H)

C==331.4+(0.606*25)+(*50)

C==331.4+15.15+0.62C=347.17m/s

C= speed of sound

T= Temperature

H=Humidity

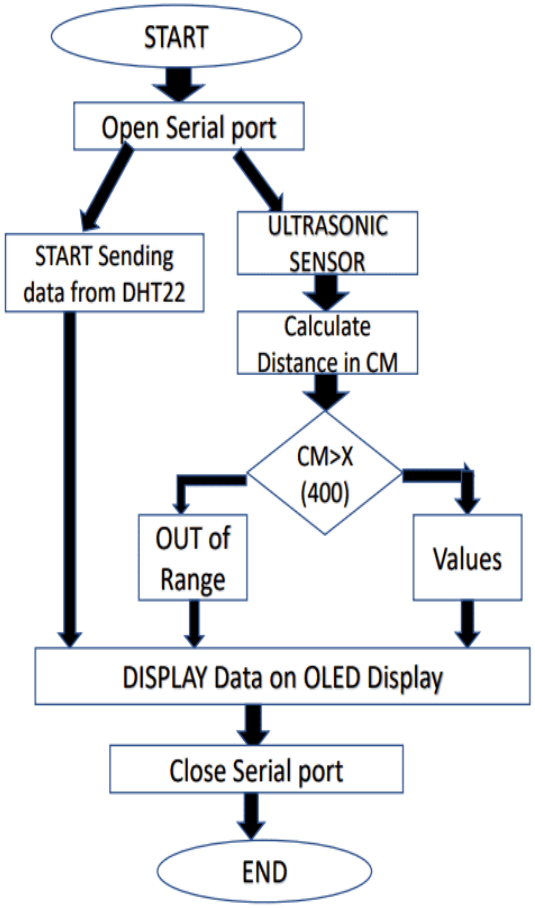
At 25° Cand 50 °C humidity sound travels at 347.17 m/s

USES

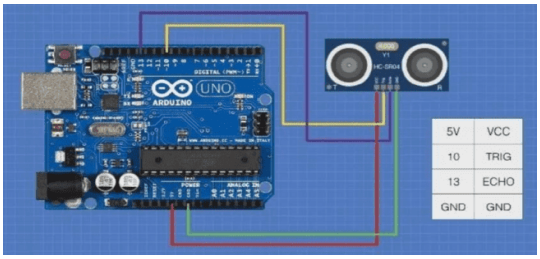
Our ultrasonic distance, level, and proximity sensors are commonly used with microcontroller platforms like Raspberry Pi, ARM, PIC, Arduino, Beagle Board, and more . Ultrasonic sensors transmit sound waves toward a target and will determine its distance by measuring the time it took for the reflected waves to return to the

receiver. This sensor is an electronic device that will measure the distance of a target by transmitting ultrasonic sound waves, and then will convert the reflected sound into an electrical signal. Our sensors are often used as proximity sensors. Ultrasonic sensors are also used in obstacle avoidance systems, as well as in manufacturing. Our Short Range sensors offer the opportunity for closer range detection where you may need a sensor that ranges objects as close to 2cm. These are also built with very low power requirements in mind, as well as environments where noise received.

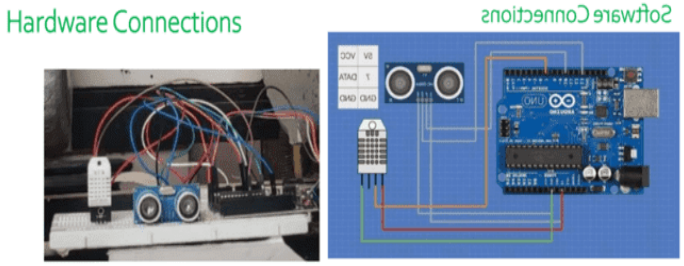
FLOW CHART

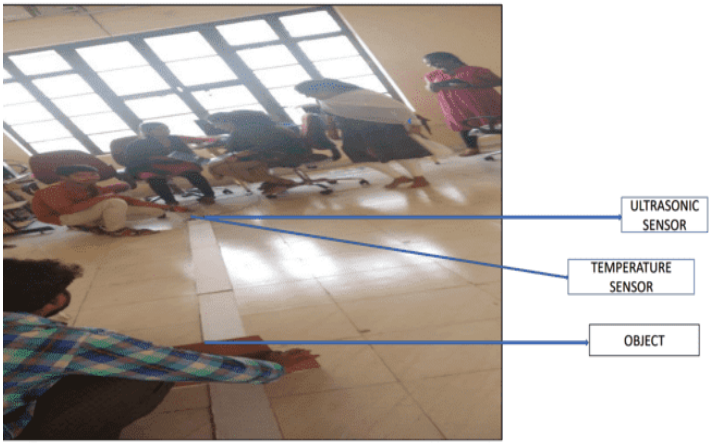


CONNECTIONS DIAGRAM

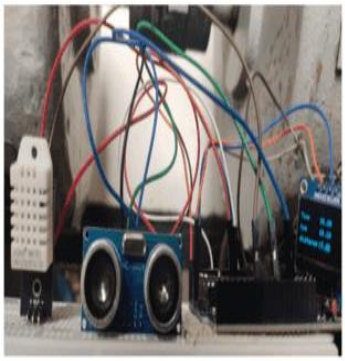


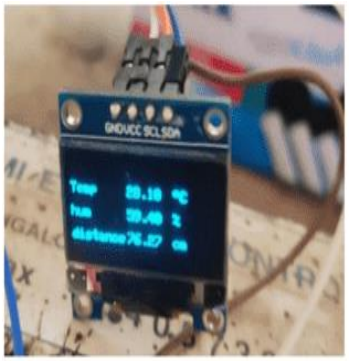
ARDUINO CONNECTIONS WITH TEMPERATURE & ULTRASONIC SENSOR





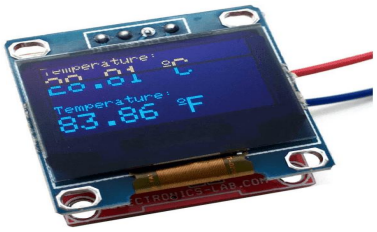
ARDUINO CONNECTIONS WITH TEMPERATURE & ULTRASONIC SENSORS USING OLED





OLED AND IT'S WORKING

OLED (Organic Light Emitting Diodes) is a flat light emitting technology, made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. OLEDs are emissive displays that do not require a backlight and so are thinner and more efficient than LCD displays (which do require a white backlight). AN OLED is made by placing a series of organic thin films between two conductors. When electrical current is applied, a bright light is emitted. Click here for a more detailed view of the OLED technology.



OLED DISPLAY

OLEDs are organic because they are made from carbon and hydrogen. There's no connection to organic food or farming - although OLEDs are very efficient and do not contain any bad metals - so it's a real green technology. OLEDs are used today in mobile phones, digital cameras, VR headsets, tablets, laptops and TVs. In 2021, over 500 million AMOLED screens will be produced - mostly to satisfy demand from smartphones, wearables, tablets, laptops and TVs. The leading AMOLED producer is Samsung Display, and most premium phones today adopt either rigid or flexible OLED displays - including those from Apple, Samsung, Huawei, Oppo, Motorola, Sony and others.

OLED WHITE LIGHTNING

OLEDs can be used to create excellent light source. OLEDs offer diffuse area lighting and can be flexible, efficient, light, thin, transparent, color-tunable and more. OLEDs enable new designs and these devices emit healthier light compared to CFLs and LED lighting devices. Several companies, all over the world are developing OLED lighting technologies. The market is still at its infancy, with very high prices as production volume is low. We hope that the future will see an increased adoption of OLED lighting, although currently there are many challenges yet before mass production begins.

nRF24L01

The nRF24L01 is a single chip 2.4GHz transceiver with an embedded base band protocol engine, suitable for ultra-low power wireless applications. The nRF24L01 is designed for operation in the world-wide ISM frequency band at 2.400-2.4835GHz. To design a radio system with the nRF24L01, you simply need an MCU (microcontroller) and a few external passive components. You can operate configure the nRF24L01 through a serial peripheral interface (SPI). The register map, which is accessible through the SPI, contains all configuration registers in the nRF24L01 and is accessible in all operation modes of the chip. The radio front end uses GFSK modulation it has user configurable parameters like frequency channel, output power and air data rate.

OPERATIONAL MODES: You can configure the nRF24L01 in power down, stand by, RX or TX mode RX mode: The RX mode is an active mode where the nRF24L01 radio is used as a receiver. To enter this mode, then RF24L01+ must have the PWR UP bit, PRIM RX bit and the CE pin set high. In RX mode the receiver

demodulates the signals from the RF channel, constantly presenting the demodulated data to the baseband protocol engine. The baseband protocol engine constantly searches for a valid packet. If a valid packet is found (by a matching address and a valid CRC) the payload of the packet is presented in a vacant slot in the RX FIFOs. If the RX FIFOs are full, the received packet is discarded. The nRF24L01 remains in RX mode until the MCU configures it to standby-I mode or power down mode. However, if the automatic protocolfeatures(Enhanced ShockBurst™)in the baseband protocol engine are enabled,the nRF24L01 can enter other modes in order to execute the protocol. In RX mode a Received Power Detector (RPD) signal is available. The RPD is a signal that is set high when a RF signal higher than -64 dBm is detected inside the receiving frequency channel. The internal RPD signal is filtered before presented to the RPD register.The RF signal must be present for at least 40µs before the RPD is set high.

TX mode: The TX mode is an active mode for transmitting packets. To enter this mode, the nRF24L01 must have the PWR UP bit set high, PRIM RX bit set low, a payload in the TX FIFO and a high pulse on the CE for more than 10µs.The nRF24L01 stays in TX mode until it finishestransmitting a packet. If CE = 0, nRF24L01 returns to standby-I mode. If CE = 1, the status of the TX FIFO determines the next action. If the TX FIFO is not empty the nRF24L01 remains in TX mode and transmits the next packet. If the TX FIFO is empty the nRF24L01 goes into standby-II mode. The nRF24L01 transmitter PLL operates in open loop when in TX mode. It is important never to keep the nRF24L01 in TX mode for more than 4ms at a time. If the Enhanced Shock Burst™ features are enabled, nRF24L01 is neverin TX mode longerthan 4ms.

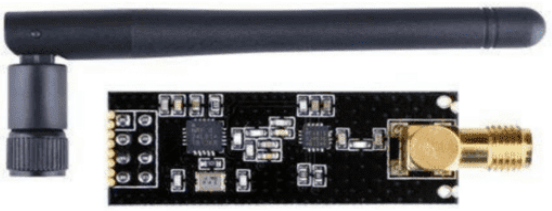
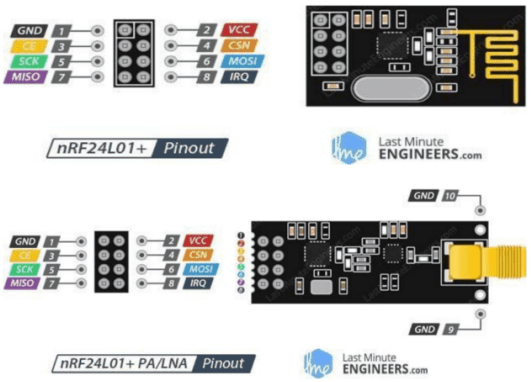


Figure 3.4: nRF24L01-PA-LNA-External-Antenna-Wireless-Transceiver-Module



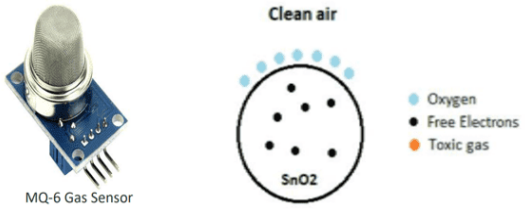
GAS SENSORS INTRODUCTION

A gas sensor is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated.

WORKING

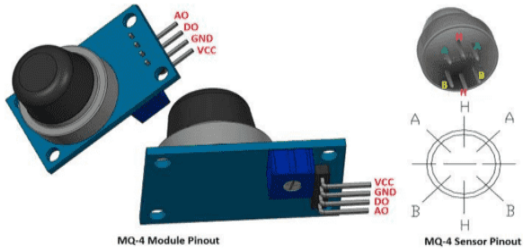
The ability of a Gas sensor to detect gases depends on the chemiresister to conduct current. The most commonly used chemiresistor is Tin Dioxide (SnO2) which is an n-type semiconductor that has free electrons (also called as donor). Normally the atmosphere will contain more oxygen than combustible gases. The oxygen particles attract the free electrons present in SnO2 which pushes them to the surface of the SnO2. As there are no free electrons available output current will be zero.The below gif shown the oxygen molecules (blue color) attracting the free electrons

(black color) inside the SnO2 and preventing it from having free electrons to conduct current.



USES

A basic gas sensor has 6 terminals in which 4 terminals (A, A, B, B) acts input or output and the remaining 2 terminals (H, H) are for heating the coil. Of these 4 terminals, 2 terminals from each side can be used as either input or output (these terminals are reversible as shown in the circuit diagram) and vice versa.



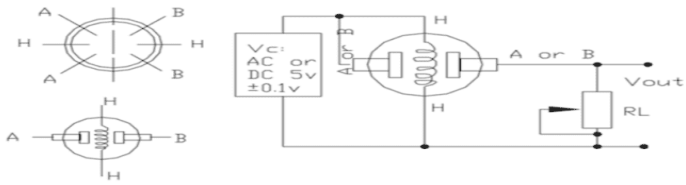
PIN DESCRIPTION

These sensors are normally available as modules (shown right), these modules consist of the gas sensor and a comparator IC. Now let's see the pin description of the gas sensor module which we will generally use with an Arduino. The gas sensor module basically consists of 4 terminals Vcc – Power supply GND – Power supply. Digital output – This pin gives an output either in logical high or logical low (0 or 1) that means it displays the presence of any toxic or combustible gases near the sensor.

INTERNAL DIAGRAM OF GAS SENSOR

Here A and B are the input and output terminals (these are reversible - means any of the paired terminals can be used as input or output) and H is the Heater coil terminal. The purpose of the variable resistor is to adjust the output voltage and to maintain high sensitivity. If no input voltage is applied to the heater coil, then the output current will be very less (which is negligible or approximately 0). When sufficient voltage is applied to the input terminal and heater coil, the sensing layer wakes up and is ready to sense any combustible gases nearby it. Initially let's assume that there is no toxic gas near the sensor, so the resistance of the layer doesn't change and the output current and voltage are also unchanged and are negligible (approximately 0).

(approximately 0).



TYPES OF SENSORS

Sensor Name	Gas to measure
MQ-2	Methane, Butane, LPG, Smoke
MQ-3	Alcohol, Ethanol, Smoke
MQ-4	Methane, CNG Gas
MQ-5	Natural gas, LPG
MQ-6	LPG, butane
MQ-7	Carbon Monoxide
MQ-8	Hydrogen Gas
MQ-9	Carbon Monoxide, flammable gasses
MQ131	Ozone

APPLICATIONS

Used in industries to monitor the concentration of the toxic gases.

Used in households to detect an emergency incidents.

Used at oil rig locations to monitor the concentration of the gases those are released.

Used at hotels to avoid customers from smoking.

Used in air quality check at offices.

Used in air conditioners to monitor the CO2 levels.

Used in detecting fire.

Used to check concentration of gases in mines.

Breath analyzer.

MQ2 GAS SENSOR

MQ2 is one of the commonly used gas sensors in MQ sensor series. It is a Metal Oxide Semiconductor (MOS) type Gas Sensor also known as Chemiresistors as the detection is based upon change of resistance of the sensing material when the Gas comes in contact with the material. Using a simple voltage divider network, concentrations of gas can be detected. MQ2 Gas sensor works on 5V DC and draws around 800mW. It can detect LPG, Smoke, Alcohol, Propane, Hydrogen, Methane and Carbon Monoxide conce ntrations anywhere from 200 to 10000ppm.

EXTERNAL STRUCTURE OF MQ2 GAS SENSOR

The sensor is actually enclosed in two layers of fine stainless steel mesh called Anti-explosion network. It ensures that heater element inside the sensor will not cause an explosion, as we are sensing flammable gases. It also provides protection for the sensor and filters out suspended particles so that only gaseous elements are able to pass inside the chamber. The mesh is bound to rest of the body via a copper plated clamping ring.

SPECIFICATIONS

Operating voltage	5V
Load resistance	20 KΩ
Heater resistance	33Ω ± 5%
Heating consumption	<800mw
Sensing Resistance	10 KΩ – 60 KΩ
Concentration Scope	200 – 10000ppm
Preheat Time	Over 24 hour

HARDWARE OVERVIEW

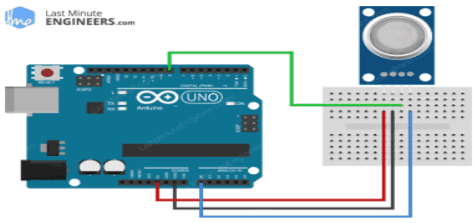
The analog output voltage provided by the sensor changes in proportional to the concentration of smoke/gas. The greater the gas concentration, the higher is the output voltage; while lesser gas concentration results in low output voltage. The following animation illustrates the relationship between gas concentration and output voltage. The analog signal from MQ2 Gas sensor is further fed to LM393 High Precision Comparator (soldered on the bottom of the module), of course to digitize the signal.

PIN OUT

VCC - supplies power for the module. You can connect it to 5V output from your Arduino. GND - is the Ground Pin and needs to be connected to GND pin on the Arduino. D0 - provides a digital representation of the presence of combustible gases. A0 - provides analog output voltage in proportional to the concentration of smoke/gas.

CONNECTIONS DIAGRAM OF MQ2

Start by placing the sensor on to your breadboard. Connect VCC pin to the 5V pin on the Arduino and connect GND pin to the Ground pin on the Arduino. Connect D0 output pin on the module to Digital pin#8 on the Arduino. A0 output pin on the module to Analog pin#0 on the Arduino.



MQ7 GAS SENSOR

MQ7 sensor has an acute sensitivity to Carbon Monoxide and can detect the concentration of carbon monoxide in the surroundings. MQ7 sensor has a small heater inside with an electrochemical sensor to measure different kinds of gas combinations. Thus, it can be calibrated. We can use the gas sensor module at room temperature. The MQ7 alcohol sensor comprises a tin dioxide (SnO2), a perspective layer inside aluminum oxide micro-tubes (measuring electrodes), and a heating element inside a tubular casing. There is an enclosed stainless steel net at the end face of the sensor and the backside holds the connection terminals.

WORKING PRINCIPLE AND FEATURES

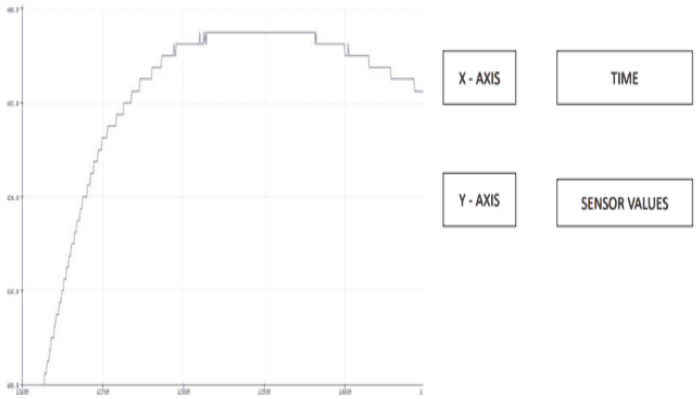
The ability of an MQ7 Gas sensor depends on the chemiresister. The chemiresistor is Tin Dioxide (SnO2) which that has free electrons (donors). The oxygen molecules attract the free electrons present in a tin dioxide that pushes them to the surface of the tin dioxide. When there are no free electrons available output current would be zero. The oxygen molecules attract the free electrons inside the tin dioxide (SnO2) and prevent it from having free electrons to conduct current.

FEATURES : The analog output voltage, the higher the concentration the higher the voltage .The carbon monoxide detection with better sensitivity. With a long service life and reliable stability. Rapid response and recovery characteristics.

CONNECTIONS DIAGRAM OF MQ7

Connect VCC pin to the 5V pin on the Arduino. Connect GND pin to the Ground pin on the Arduino. Connect D0 output pin on the module to Digital pin#8 on the Arduino. A0 output pin on the module to Analog pin#0 on the Arduino.

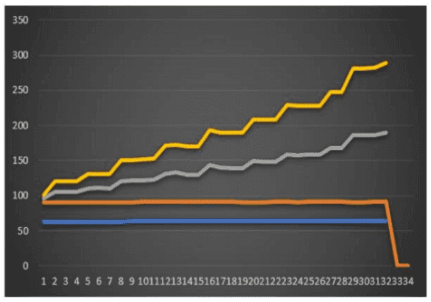
OUTPUT

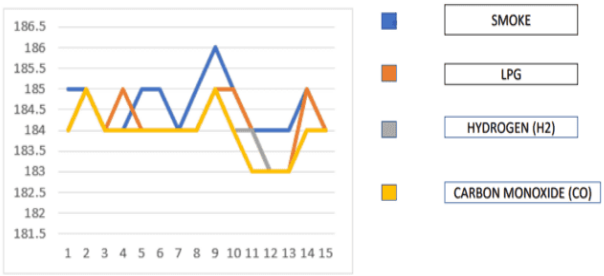


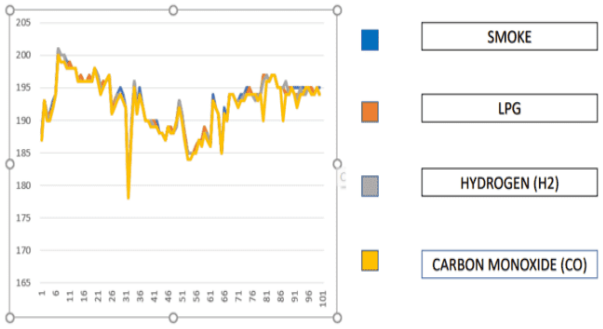
DATA LOGGING SYSTEM

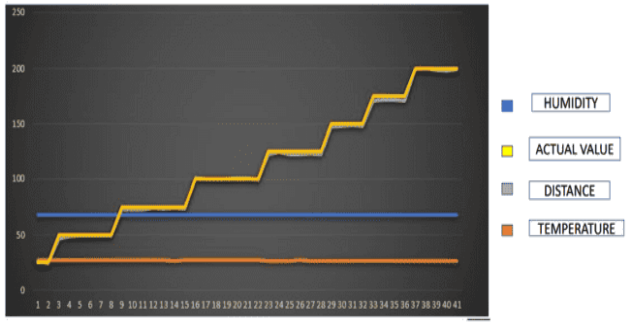
Go to File -options - add -ins- manage- com- add ins -go- data streamer for excel- okdata streamer. Connect a device -Arduino UNO. Start data- record data [values will be recorded]. Arrange the o/p in first column & drag it. Then select all values- go to data- go to text columns -arrange all the data in a sequential manner [e.g.: some:|100|ppm]- click next and finish -ok. Select all the values from the o/p- go to insert-select graph [go to filter - then select data & add]-then give the channel name and select the values & continue -then click ok &finish.

RESULTS









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FUTURE SCOPE

1.Using additional sensors all possible safety issues could be monitored such as gases, dust, vibrations, fire etc.

2.The other important data can be communicated through this system making it feasible where wired communication is a hindrance.

3.The control can be governed from the surface itself as the system provides easy access.