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Department of Computer Science and Engineering

MICROCONTROLLER AND EMBEDDED SYSTEMS (18CS44)

Topic : **GAS LEAKAGE DETECTION WITH BUZZER SYSTEM**

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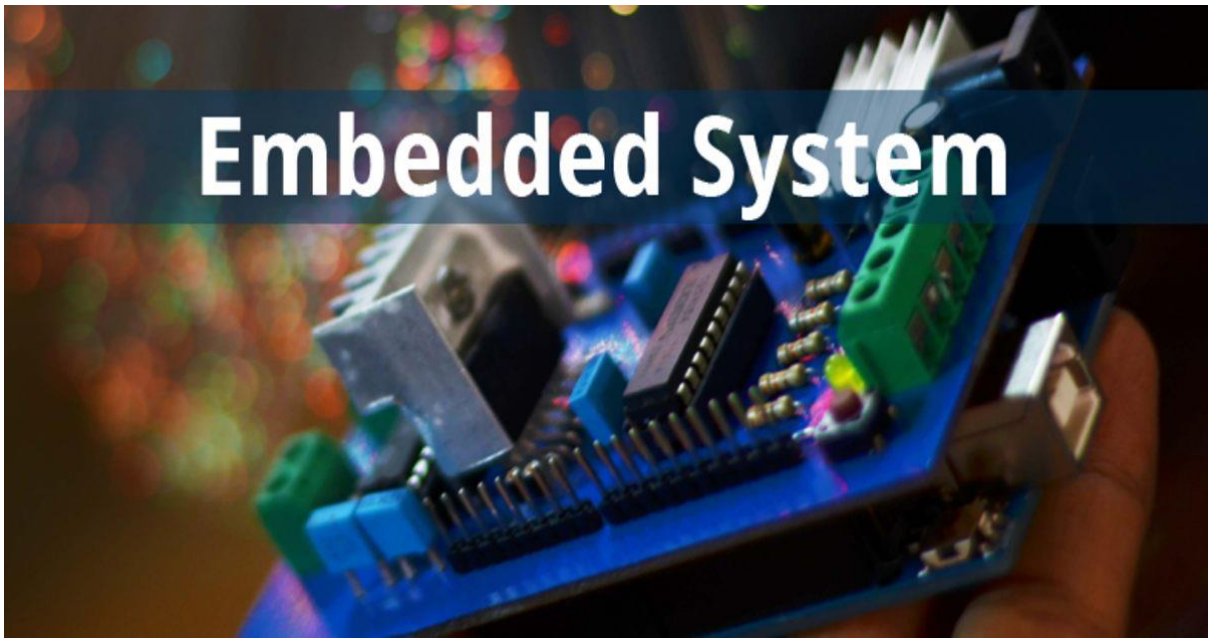
INTRODUCTION:-

EMBEDDED SYSTEM AND ITS PURPOSE



As the name itself suggests, Embedded means something that is attached to another thing. An embedded system can be thought of as a computer hardware system having software embedded in it. An embedded system can be an independent system or it can be a part of a large system.

An embedded system is a microprocessor-based computer hardware system with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system. At the core is an integrated circuit designed to carry out computation for real-time operations.

Complexities range from a single microcontroller to a suite of processors with connected peripherals and networks, from no user interface to complex graphical user interfaces. The complexity of an embedded system varies significantly depending on the task for which it is designed.

An embedded system is a combination of computer hardware and software designed for a specific function. Embedded systems may also function within a larger system. The systems can be programmable or have a fixed functionality. Industrial machines, consumer electronics, agricultural and processing industry devices, automobiles, medical equipment, cameras, digital watches, household appliances, airplanes, vending machines and toys, as well as mobile devices, are possible locations for an embedded system.

Embedded system applications range from digital watches and microwaves to hybrid vehicles and avionics. As much as 98 percent of all microprocessors manufactured are used in embedded systems.

How an Embedded System Works:-

Embedded systems are managed by microcontrollers or digital signal processors (DSP), application-specific integrated circuits (ASIC), field-programmable gate arrays (FPGA), GPU technology, and gate arrays. These processing systems are integrated with components dedicated to handling electric and/or mechanical interfacing.

Embedded systems programming instructions, referred to as firmware, are stored in read-only memory or flash memory chips, running with limited computer hardware resources. Embedded systems connect with the outside world through peripherals, linking input and output devices.

Characteristics of an Embedded System:-

- **Single-functioned** − An embedded system usually performs a specialized operation and does the same repeatedly. For example: A pager always functions as a pager.
- **Tightly constrained** − All computing systems have constraints on design metrics, but those on an embedded system can be especially tight. Design metrics is a measure of an implementation's features such as its cost, size, power, and performance. It must be of a size to fit on a single chip, must perform fast enough to process data in real time and consume minimum power to extend battery life.
- **Reactive and Real time** − Many embedded systems must continually react to changes in the system's environment and must compute certain results in real time without any delay. Consider an example of a car cruise controller; it continually monitors and reacts to speed and brake sensors. It must compute acceleration or de-accelerations repeatedly within a limited time; a delayed computation can result in failure to control of the car.
- **Microprocessors based** − It must be microprocessor or microcontroller based.
- **Memory** − It must have a memory, as its software usually embeds in ROM. It does not need any secondary memories in the computer.
- **Connected** − It must have connected peripherals to connect input and output devices.
- **HW-SW systems** − Software is used for more features and flexibility. Hardware is used for performance and security.

Examples of embedded systems:-

Embedded systems are used in a wide range of technologies across an array of industries.

Some examples include:

- **Automobiles.** Modern cars commonly consist of many computers (sometimes as many as 100), or embedded systems, designed to perform different tasks within the vehicle. Some

of these systems perform basic utility functions and others provide entertainment or user-facing functions. Some embedded systems in consumer vehicles include cruise control, backup sensors, suspension control, navigation systems and airbag systems.

- **Mobile phones.** These consist of many embedded systems, including GUI software and hardware, operating systems (OSes), cameras, microphones, and USB (Universal Serial Bus) I/O (input/output) modules.
- **Industrial machines.** They can contain embedded systems, like sensors, and can be embedded systems themselves. Industrial machines often have embedded automation systems that perform specific monitoring and control functions.
- **Medical equipment.** These may contain embedded systems like sensors and control mechanisms. Medical equipment, such as industrial machines, also must be very user-friendly so that human health isn't jeopardized by preventable machine mistakes. This means they'll often include a more complex OS and GUI designed for an appropriate UI.

And many more applications - - - - .

PURPOSE OF EMBEDDED SYSTEMS:-

As mentioned in the previous section, embedded systems are used in various domains like consumer electronics, home automation, telecommunications, automotive industry, healthcare, control & instrumentation, retail and banking applications, etc. Each embedded system is designed to serve the purpose of any one or a combination of the following tasks:

1. Data Collection, Storage, Representation

- Data is collection of facts, such as values or measurements. It can be numbers, words, measurements, observations, or even just description of things.

Purpose of embedded system design is data collection. It performs acquisition of data from the external world.

- Data collection is usually done for storage, analysis, manipulation, and transmission.

- The Data can be analog or digital. Embedded systems with analog data capturing techniques collect data directly in the form of analog signal; whereas embedded systems with digital data collection mechanism convert the analog signal to corresponding digital signal using analog to digital (A/D) converters.
- If the data is digital, it can be directly captured by digital embedded system. A digital camera is a typical example of an embedded system with data collection, storage, and representation of data. Images are captured and captured image may be stored within the memory of the camera. The captured image can also be presented to the user through a graphic LCD (Liquid Crystal Display) unit.

2. Data Communication

- Embedded data communication systems are deployed in applications ranging from simple home networking systems to complex satellite communication systems.
    - Network hubs, routers, switches are examples of dedicated data transmission embedded systems.
- Data transmission is in the form of wire medium or wireless medium. Initially wired medium is used by embedded systems; and as technology changes, wireless medium becomes de-facto standard in embedded systems.
    - USB, TCP/ IP are examples of wired communication; and Bluetooth, ZigBee and Wi-Fi are examples for wireless communication.
- Data can be transmitted by analog means or by digital means.

3. Data (Signal) Processing

- Embedded systems with signal processing functionalities are employed in applications demanding signal processing like speech coding, audio-video codec, transmission applications, etc.

o A digital hearing aid is a typical example of an embedded system employing data processing.

4. Monitoring

- Almost all embedded products coming under the medical domain are with monitoring functions.

o Patient heart beat is monitored by Electro cardiogram (ECG) machine.

In the current occasions, the use of embedded systems is broad. However, the software which is customized into the microcontroller is equipped for understanding just a constrained scope of issues. Embedded system based activities can perform multiple tasks and are additionally fit for interfacing with different systems, network, and gadgets.

Few examples of the purpose of embedded systems in real-world are as follows:
Detecting rash driving in traffic- The fundamental goal of this is to structure an expressway speed-checker gadget that distinguishes rash driving on thruways and cautions the traffic authorities if the speed checker finds any vehicle damaging the set speed constrains on roadways.

Purpose of an embedded system in street light control- The primary aim is to recognize the movement of vehicles on interstates and to turn on road lights in front of it, and afterward to turn off the road lights as the vehicle go past the road lights to save energy.

Embedded System for home automation system-The fundamental purpose of embedded systems in home automation is to plan a home robotization framework with the Android application based remote control. Remote activity is performed by Android OS based advanced cell or Tablet and so on., upon a Graphical User Interface based touch screen activity. So as to accomplish this, Android application goes about as a transmitter that sends on/off orders to the beneficiary wherein loads are associated.

Embedded System for Industrial Temperature Control- The primary purpose of the embedded system of this mechanical temperature controller is to control the temperature of any gadget in any modern application as per its need. An LCD show is utilized to show the temperature in the scope of – 55°C to +125°C. The core of the circuit is the microcontroller which is from 8051 families and controls every one of its capacities.

Embedded System for War Field Spying Robot- The primary purpose of the embedded system here is to structure an automated vehicle utilizing RF innovation for remote activity and joined with a remote camera for observing reason. The robot with a camera can remotely transmit continuous video with night vision capacities. This sort of robot can be useful for spying purposes in war fields.

Basic Structure of an Embedded System:-

Embedded systems vary in complexity but, generally, consist of three main elements:

- **Hardware**. The hardware of embedded systems is based around microprocessors and microcontrollers. Microprocessors are very similar to microcontrollers and, typically, refer to a CPU (central processing unit) that is integrated with other basic computing

components such as memory chips and digital signal processors (DSPs). Microcontrollers have those components built into one chip.

- **Software and firmware**. Software for embedded systems can vary in complexity. However, industrial-grade microcontrollers and embedded IoT systems usually run very simple software that requires little memory.
- **Real-time operating system**. These are not always included in embedded systems, especially smaller-scale systems. RTOSes define how the system works by supervising the software and setting rules during program execution.

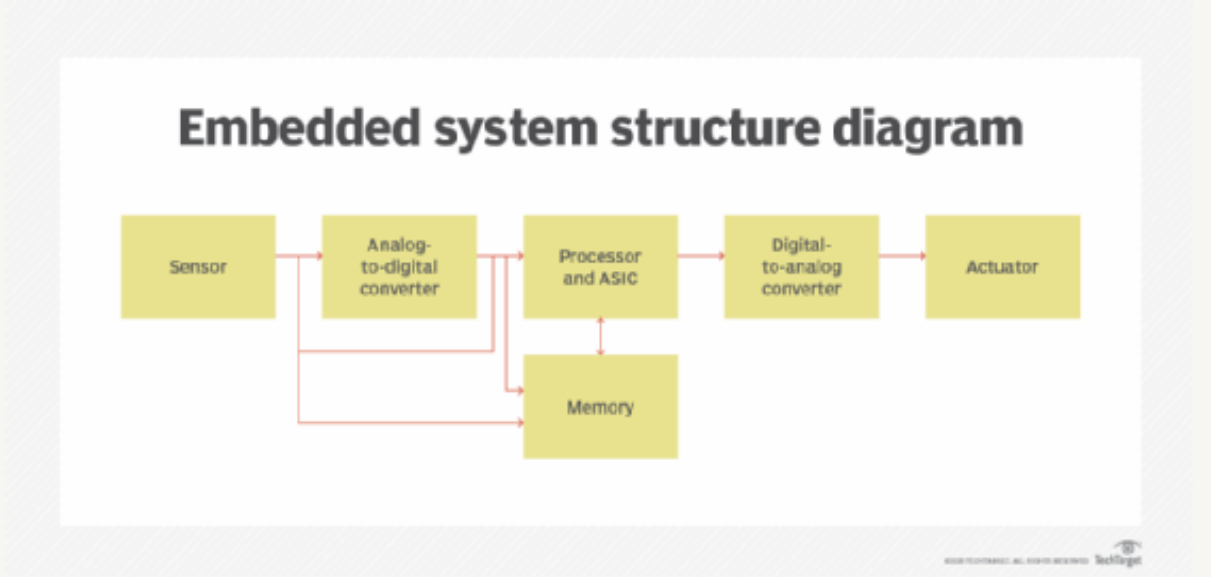
In terms of hardware, a basic embedded system would consist of the following elements:

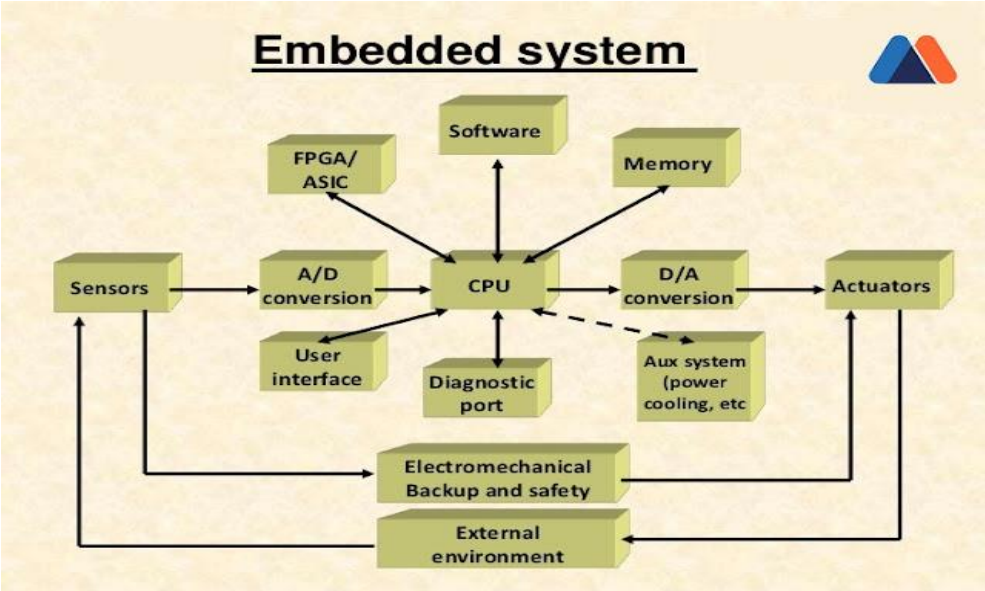
- **Sensor**: The sensor measures and converts the physical quantity to an electrical signal, which can then be read by an embedded systems engineer or any electronic instrument. A sensor stores the measured quantity to the memory.
- **A-D Converter**: An analog-to-digital converter converts the analog signal sent by the sensor into a digital signal.

Processor & ASICs: Processors assess the data to measure the output and store it to the memory.

- **D-A Converter**: A digital-to-analog converter changes the digital data fed by the processor to analog data
- **Actuator**: An actuator compares the output given by the D-A Converter to the actual output stored and stores the approved output.

The sensor reads external inputs, the converters make that input readable to the processor, and the processor turns that information into useful output for the embedded system.





A Processor is the heart of an embedded system. It is the basic unit that takes inputs and produces an output after processing the data. For an embedded system designer, it is necessary to have the knowledge of both microprocessors and microcontrollers.

Processors in a System:-

A processor has two essential units −

- Program Flow Control Unit (CU)
- Execution Unit (EU)

The CPU includes a fetch unit for fetching instructions from the memory. The EU has circuits that implement the instructions pertaining to data transfer operation and data conversion from one form to another.

The EU includes the Arithmetic and Logical Unit (ALU) and also the circuits that execute instructions for a program control task such as interrupt, or jump to another set of instructions.

A processor runs the cycles of fetch and executes the instructions in the same sequence as they are fetched from memory.

Types of Processors:-

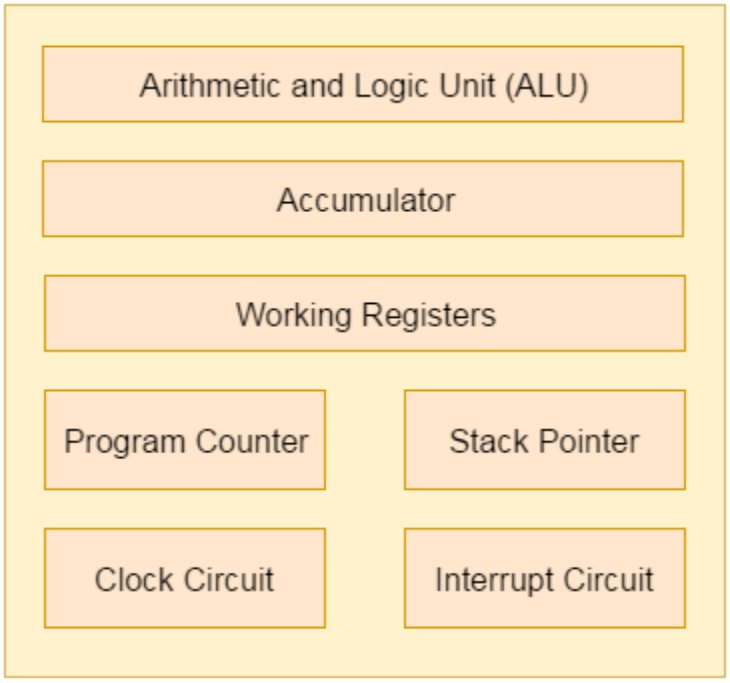
Processors can be of the following categories −

- General Purpose Processor (GPP)
  - Microprocessor
  - Microcontroller
  - Embedded Processor
  - Digital Signal Processor
  - Media Processor
- Application Specific System Processor (ASSP)
- Application Specific Instruction Processors (ASIPs)
- GPP core(s) or ASIP core(s) on either an Application Specific Integrated Circuit (ASIC) or a Very Large Scale Integration (VLSI) circuit.

Microprocessor:-

A microprocessor is a component that performs the instructions and tasks involved in computer processing. In a computer system, the microprocessor is the central unit that executes and manages the logical instructions passed to it.

A microprocessor may also be called a processor or central processing unit, but it is actually more advanced in terms of architectural design and is built over a silicon microchip.

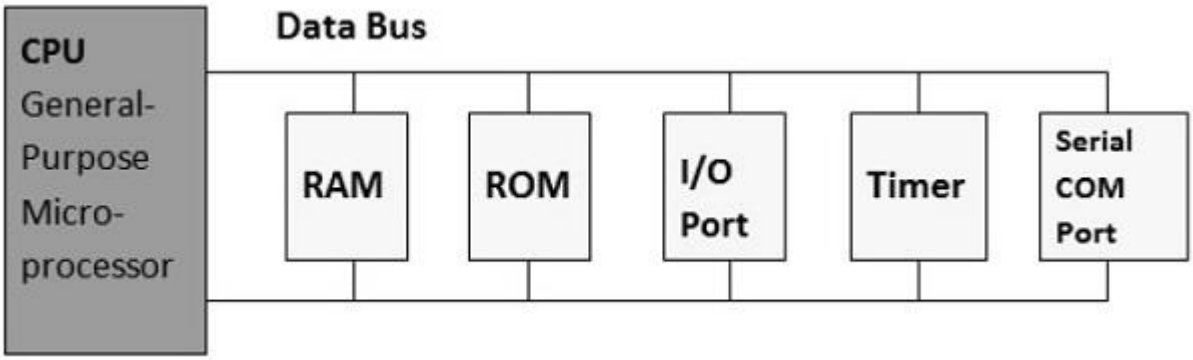


Or simply it is said as

A central processing unit built into a single VLSI chip is called a microprocessor. It is a general purpose device and an additional outside circuitry is added to make it work as a microcomputer.

In addition, it may also have other units such as coaches, floating point processing arithmetic unit, and pipelining units that help in faster processing of instructions.

Earlier generation microprocessors' fetch-and-execute cycle was guided by a clock frequency of order of ~1 MHz. Processors now operate at a clock frequency of 2GHz.



A SIMPLE BLOCK DIAGRAM OF A MICROPROCESSOR

Microcontroller:-

A microcontroller (MCU for microcontroller unit) is a small computer on a single VLSI integrated circuit (IC) chip. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

Or simply said as A microcontroller is a single-chip VLSI unit (also called microcomputer) which, although having limited computational capabilities, possesses enhanced input/output capability and a number of on-chip functional units.

CPU	**RAM**	**ROM**
I/O Port	**Timer**	**Serial COM Port**

Microcontrollers are particularly used in embedded systems for real-time control applications with on-chip program memory and devices.

Basics of Microcontrollers Types:-

Any electric appliance used to store, measure & display the information otherwise measures comprise of a chip in it. The microcontroller's basic structure includes different components.

CPU
The microcontroller is called a CPU device, used to carry & decode the data & finally completes the allocated task effectively. By using a central processing unit, all the microcontroller components are connected to a particular system. Instruction fetched through the programmable memory can be decoded through the CPU.

Memory
In a microcontroller, the memory chip works like a microprocessor because it stores all the data as well as programs. Microcontrollers are designed with some amount of RAM/ROM/flash memory to store the program source code.

I/O Ports
Basically, these ports are used to interface otherwise drive different appliances like LEDs, LCDs, printers, etc.

Serial Ports
Serial ports are used to provide serial interfaces between microcontroller as well as a variety of other peripherals like parallel port.

Timers
A microcontroller includes timers otherwise counters. These are used to manage all the operations of timing and counting in a microcontroller. The main function of the counter is to count outside pulses whereas the operations which are performed through timers are clock functions, pulse generations, modulations, measuring frequency, making oscillations, etc.

ADC (Analog to Digital Converter)
ADC is the acronym of analog to digital converter. The main function of ADC is to change the signals from analog to digital. For ADC, the required input signals are analog and the production of a digital signal is used in different digital applications like measurement devices

DAC (Digital to Analog Converter)
The acronym of DAC is digital to analog converter, used to perform reverse functions to ADC. Generally, this device is used to manage analog devices such as DC motors, etc.

Interpret Control
This controller is employed to give delayed control to a running program & interpretation is either internal otherwise external.

Special Functioning Block
Some special microcontrollers designed for special devices like robots, space systems include a special function block. This block has extra ports to carry out some particular operations.

Microprocessor vs Microcontroller:

Microprocessor	Microcontroller
Microprocessors are multitasking in nature. Can perform multiple tasks at a time. For example, on computer we can play music while writing text in text editor.	Single task oriented. For example, a washing machine is designed for washing clothes only.
RAM, ROM, I/O Ports, and Timers can be added externally and can vary in numbers.	RAM, ROM, I/O Ports, and Timers cannot be added externally. These components are to be embedded together on a chip and are fixed in numbers.
Designers can decide the number of memory or I/O ports needed.	Fixed number for memory or I/O makes a microcontroller ideal for a limited but specific task.
External support of external memory and I/O ports makes a microprocessor-based system heavier and costlier.	Microcontrollers are lightweight and cheaper than a microprocessor.
External devices require more space and their power consumption is higher.	A microcontroller-based system consumes less power and takes less space.
The overall cost of systems made with Microprocessors is high, because of the high number of external components required.	Microcontrollers are made by using complementary metal oxide semiconductor technology; so they are far cheaper than Microprocessors.
Processing speed of general microprocessors is above 1 GHz; so it works much faster than Microcontrollers.	Processing speed of Microcontrollers is about 8 MHz to 50 MHz.
Microprocessor has a smaller number of registers, so more operations are memory-based.	Microcontroller has more register. Hence the programs are easier to write.
Microprocessors are based on Von Neumann model. It uses an external bus to interface to RAM, ROM, and other peripherals.	Micro controllers are based on Harvard architecture. It uses an internal controlling bus.

It's used for general purpose applications that allow you to handle loads of data.	It's used for application-specific systems.
It's complex and expensive, with a large number of instructions to process.	It's simple and inexpensive with less number of instructions to process.
It cannot be used in compact system. Therefore microprocessor is inefficient.	It can be used in compact system. Therefore microcontroller is more efficient.

GAS LEAKAGE APPROACH AND PURPOSE

ABSTRACT:-

A gas detector is a device that detects the presence of gases in an area, often as part of a safety system. This type of equipment is used to detect a gas leak or other emissions and can interface with a control system so a process can be automatically shut down. A gas detector can sound an alarm to operators in the area where the leak is occurring, giving them the opportunity to leave. This type of device is important because there are many gases that can be harmful to organic life, such as humans or animals.

Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may be used in firefighting.

Gas leak detection is the process of identifying potentially hazardous gas leaks by sensors. These sensors usually employ an audible alarm to alert people when a dangerous gas has been detected. Exposure to toxic gases can also occur in operations such as painting, fumigation, fuel filling, construction, excavation of contaminated soils, landfill operations, entering confined spaces, etc. Common sensors include combustible gas sensors, photoionization detectors, infrared point sensors, ultrasonic sensors, electrochemical gas sensors, and semiconductor sensors. More recently, infrared imaging sensors have come into use. All of these sensors are used for a wide range of applications and can be found in industrial plants, refineries, pharmaceutical manufacturing, fumigation facilities, paper pulp mills, aircraft and shipbuilding facilities, hazmat operations, waste-water treatment facilities, vehicles, indoor air quality testing and homes

INTRODUCTION:-

OUTLINE OF THE PROJECT:-

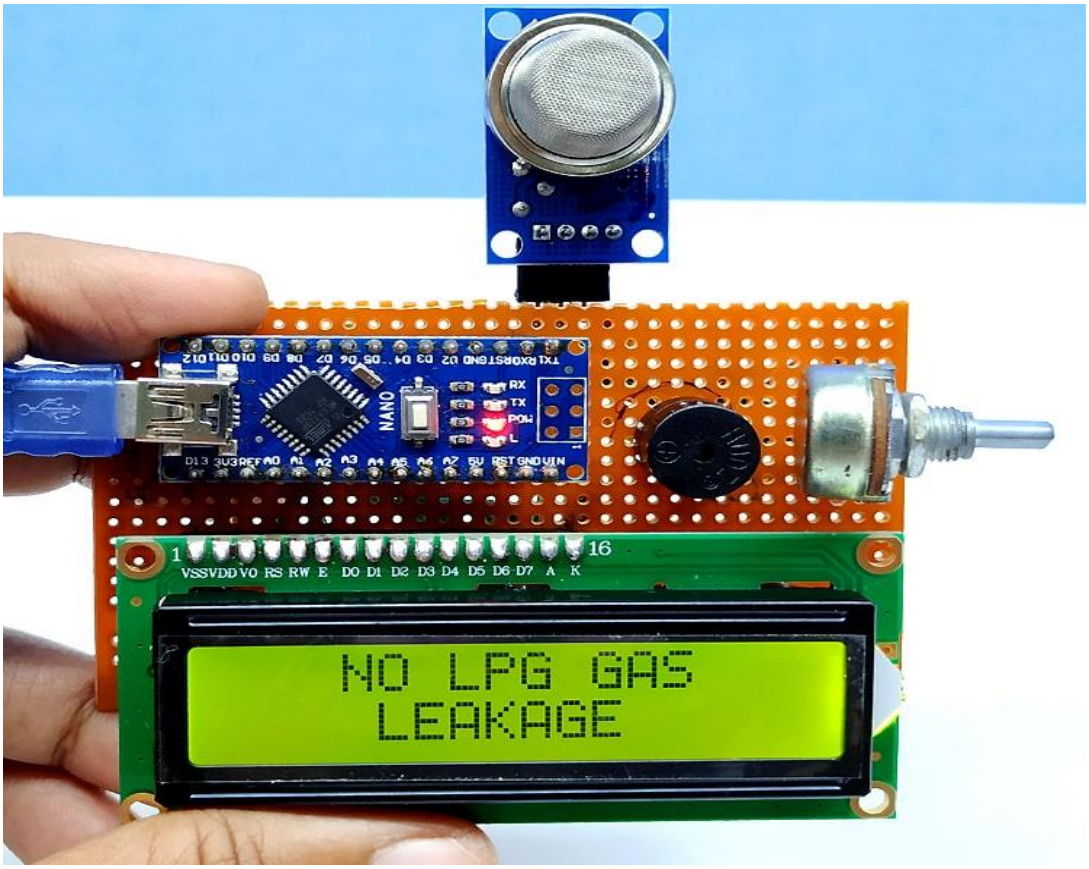
"Gas leak Detection & monitoring system using Arduino" is a project based on a wireless communication to enhance man and machine safety in a petrochemical industry. In today's world petrochemical industry although being the largest process control industry it is also highly prone to major fire and gas disasters. A petrochemical industry has excessively high amount of crude oil stored within a confined area. Therefore presence of any external source which can cause heat or fire would lead to a major disaster. Even the gas that are present in petroleum refineries are hazardous.

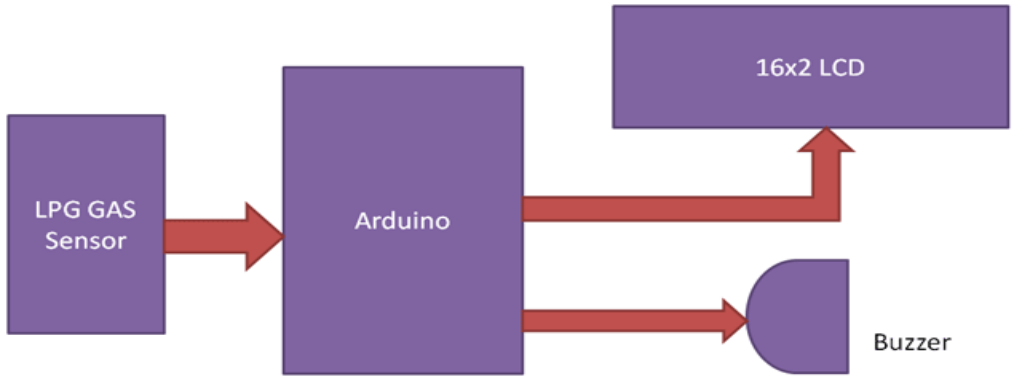
So in order to avoid any hazard due fire and gas leakage in a petrochemical industry we have designed an integrated system which will monitor timely gas leakage in any area around the plant using Arduino which is a wireless communication device. We have also proposed a new system which monitors human density within the plant area. Therefore Integrated plant safety monitor system based on Arduino can realize workers attendance registration, Real-time precise positioning, Dynamic gas concentration monitoring, Real-time data transmission & Danger alarm. This project is focused on implementing the newly designed integrated system in CPCL, Manali, and Chennai.

Executive Summary:-

LPG gas leakage detector using Arduino is a useful Arduino based LPG gas leakage detector & alarm system. You can make it using Arduino Nano or Arduino Uno board.

Here we are using an MQ2 gas sensor module & a 16×2 LCD for alert display. The MQ2 sensor can detect LPG (liquefied petroleum gas) which is used for our cocking GAS, gas lighter & some industrial purpose.





Block diagram of gas leakage detection and alert system.

Components Used:-

- Arduino Nano
- 16X2 (1602) LCD Display
- MQ2 gas sensor

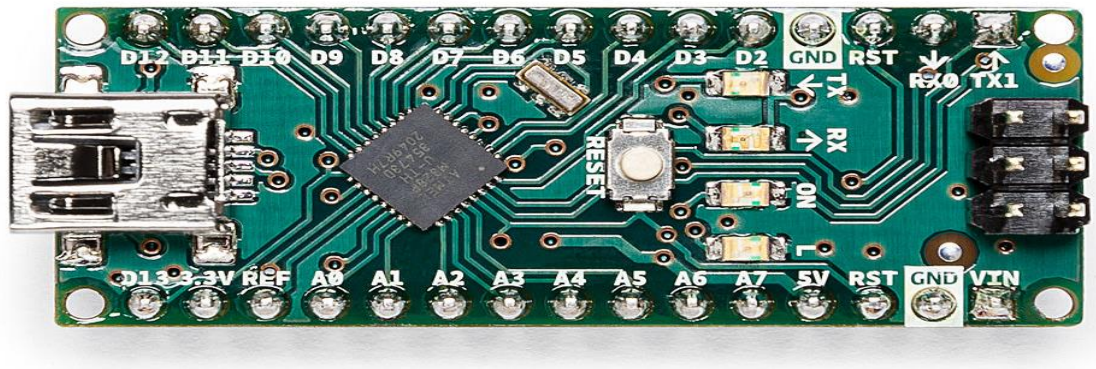
- Active Buzzer
- 10K Potentiometer
- Female header pins
- Perfboard or dotted board
- For power 5v charger or power bank

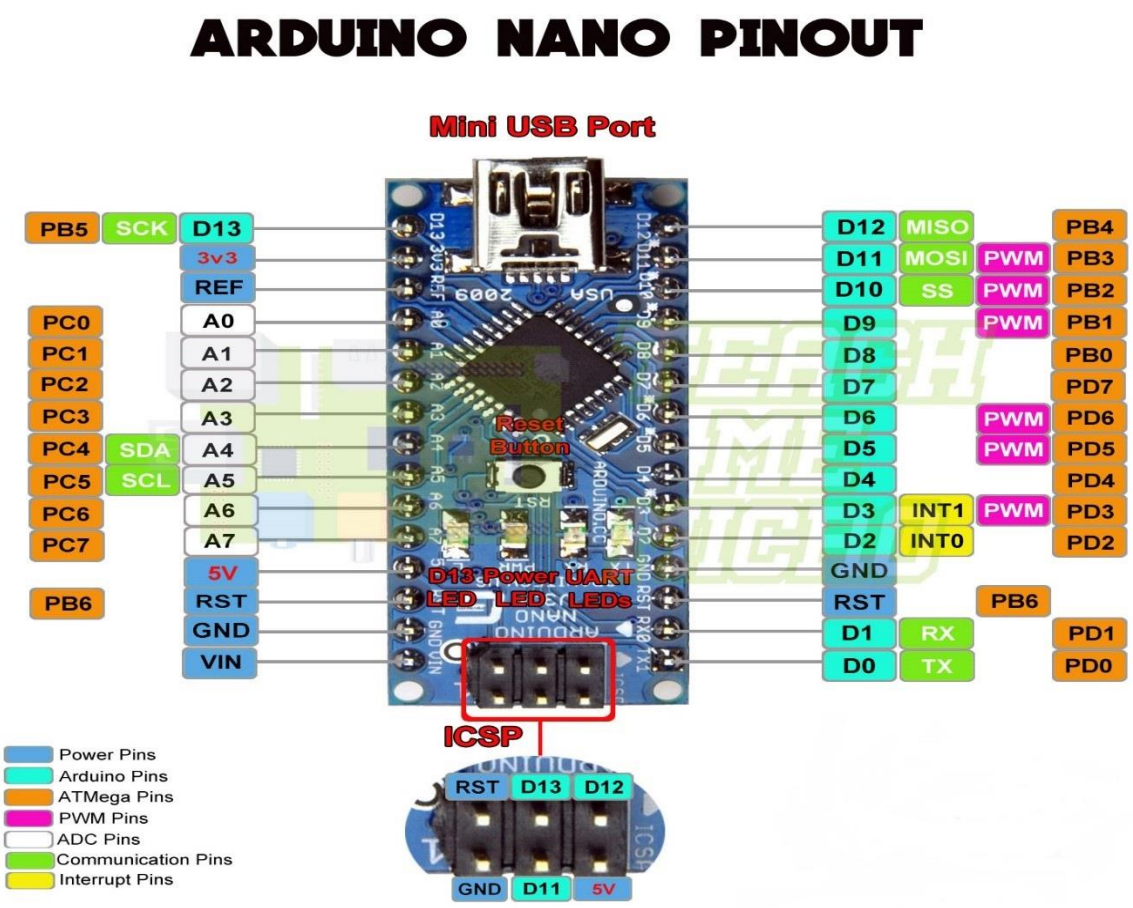
PS:-*You can use 9 volt as power source. Connect 9v + to Arduino VIN pin & (-) to Arduino Ground pin.*

Arduino Nano:-

The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328P released in 2008. It offers the same connectivity and specs of the Arduino Uno board in a smaller form factor.

The Arduino Nano is equipped with 30 male I/O headers, in a DIP-30-like configuration, which can be programmed using the Arduino Software integrated development environment (IDE), which is common to all Arduino boards and running both online and offline. The board can be powered through a type-B mini-USB cable or from a 9 V battery.

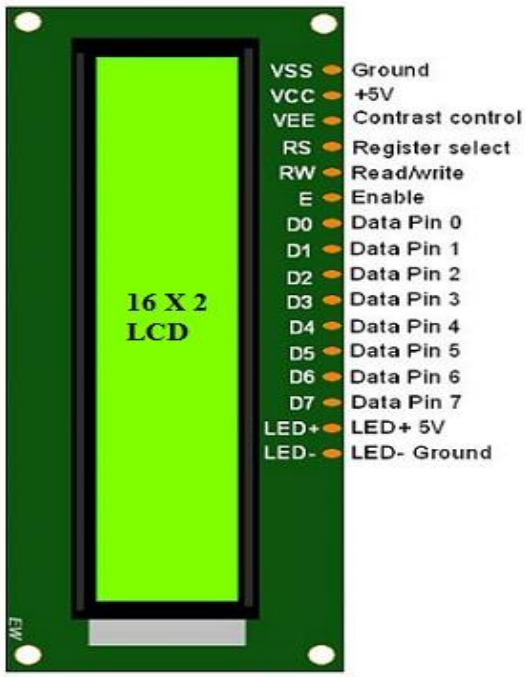




16X2 (1602) LCD Display:

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones,

calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.

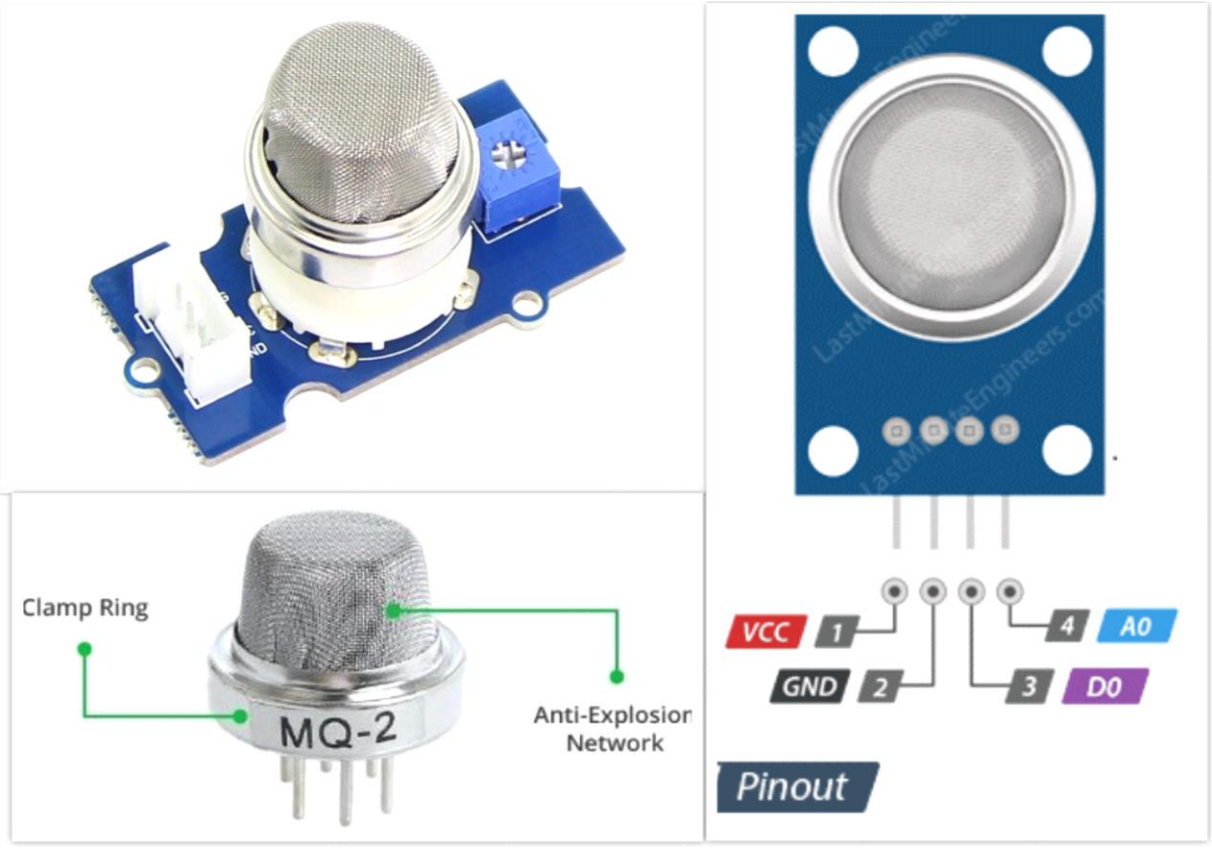


LCD-16×2-pin-diagram

LCD is employed for displaying the message indicating that" gas detected at zone" into the display, which is initially coded in program to display the danger. The message been displayed on the LCD, data and command both are register of LCD and it's shown in fig.5. The register selects is employed to modify the registers. Data register RS=1, whereas for the command register RS=0 is employed.

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.



The Grove - Gas Sensor (MQ2) module is useful for gas leakage detection (home and industry). It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke or Propane. Due to its high sensitivity and fast response time, measurement can be taken as soon as possible. The sensitivity of the sensor can be adjusted by potentiometer.

Here are the complete 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

Features:

- Wide detecting scope
- Stable and long lifetime
- Fast response and High sensitivity

Buzzer:-

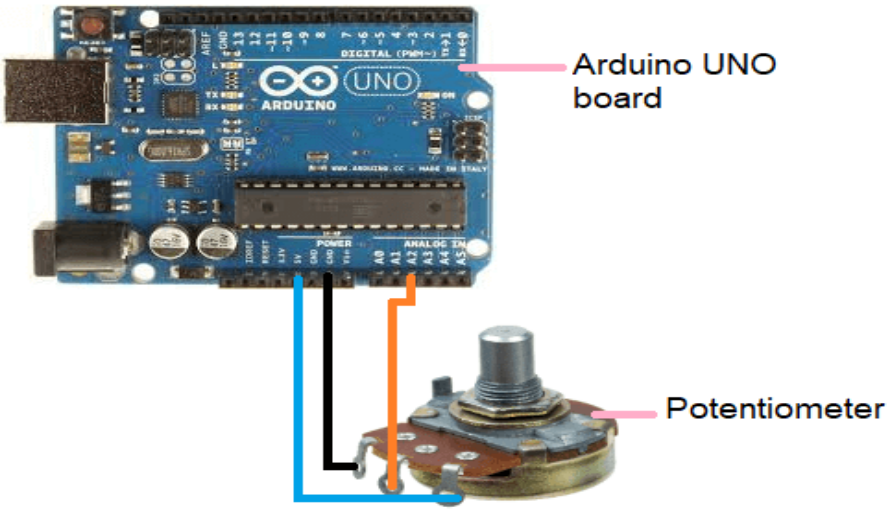
A buzzer or pager is an audio signalling device, which can be mechanical, mechanical device, or electricity (Piezo for short). It has 2 pins in it. It's easy construction and low worth makes it usable in varied applications like car/truck reversing indicator, computers, decision bells etc. Once subjected to an alternating field of force they stretch or compress, in accordance with the frequency of the signal thereby producing sound.

Potentiometer:-

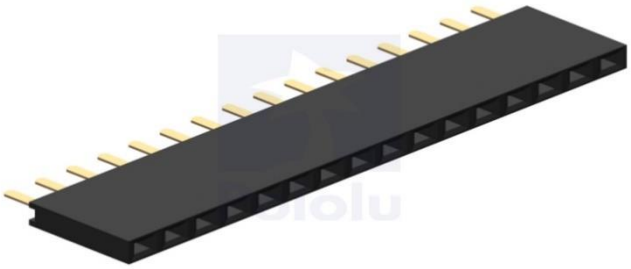
The potentiometer is a device that is used to measure the voltage or electric potential. It provides a variable resistance when the shaft of the device is turned.

Here, we will measure the amount of resistance as an analog value produced by the potentiometer. We will connect the potentiometer to the Arduino UNO board and will measure the state of the potentiometer. The required code will be uploaded from our computer to the Arduino board.

The variable resistance measured by the potentiometer can be easily read as an analog value into the Arduino board.



Female header Pins:-



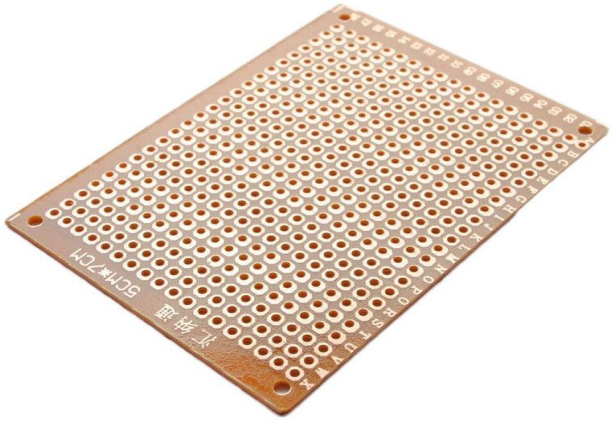
Pin header connectors comprise several different means of connection. Generally, one side is a series of pins which are soldered to a PCB, and they can either be at a right-angle to the PCB surface (usually called "straight") or parallel to the board's surface (confusingly referred to as "right-angle" pins). Such connectors come in a variety of pitches, and may have any number of individual rows of pins.

The most commonly seen pin headers are 0.1" (2.54mm) single or double row connectors. This is a standard breadboard compatible pitch. These come in male and female versions, and are the connectors used to connect Arduino boards and shields together. Users can easily connect jumper wires to breadboards.

Perfboard:-

Perfboard is a material for prototyping electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perfboard may have pads on only one side of the board, while better quality perfboard can have pads on both sides (plate-through holes). Since

each pad is electrically isolated, the builder makes all connections with either wire wrap or miniature point to point wiring techniques. Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate is typically made of paper laminated with phenolic resin (such as FR-2) or a fiberglass-reinforced epoxy laminate (FR-4).



Connections: -

Mq2 gas sensor D0 pin connected to Arduino D7 pin & gas sensor Vcc is connected to Arduino 5v & GND to Arduino GND.

LCD connection details:

LCD pin 1 VSS is connected to Arduino GND

LCD VCC is connected to Arduino 5V

LCD VEE/ Vo is connected to 10K Potentiometer middle pin

LCD RS is connected to Arduino D12

LCD R/W is connected to Arduino GND

LCD E is connected to Arduino D11

LCD D4 is connected to Arduino D5

LCD D5 is connected to Arduino D4

LCD D6 is connected to Arduino D3

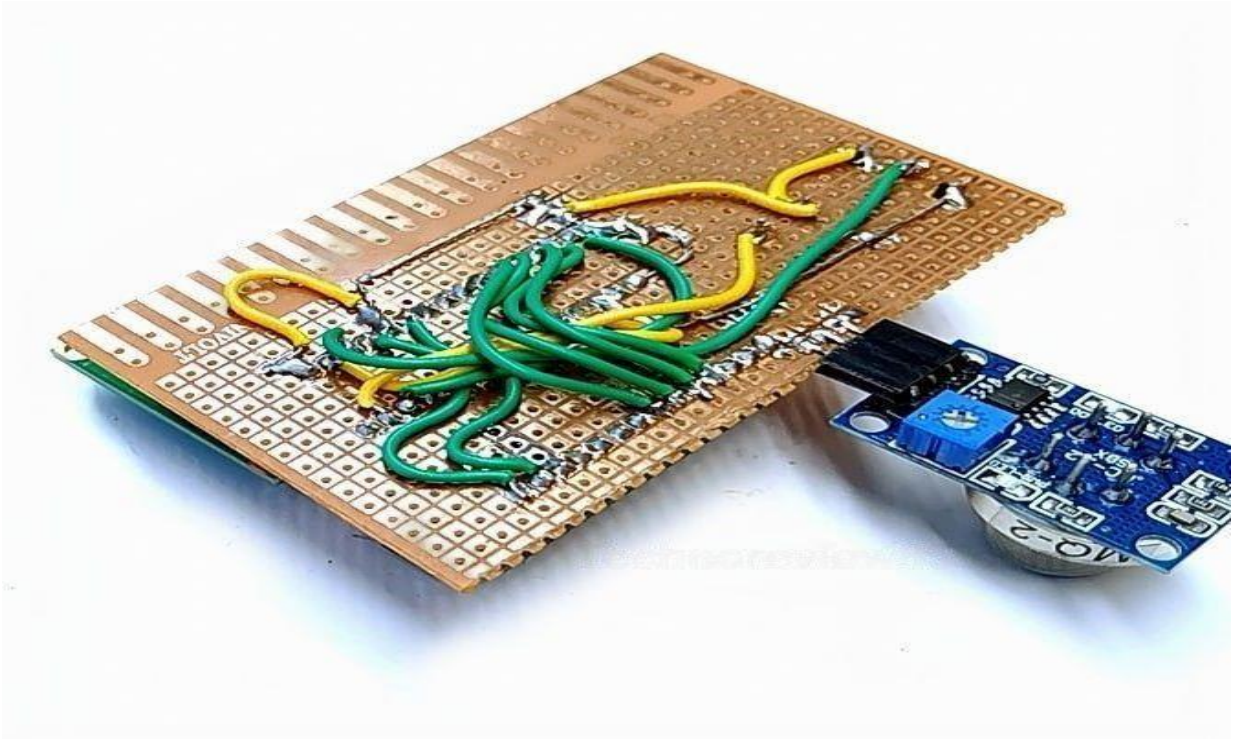
LCD D7 is connected to Arduino D2

LCD LED A pin is connected to Arduino 3.3v

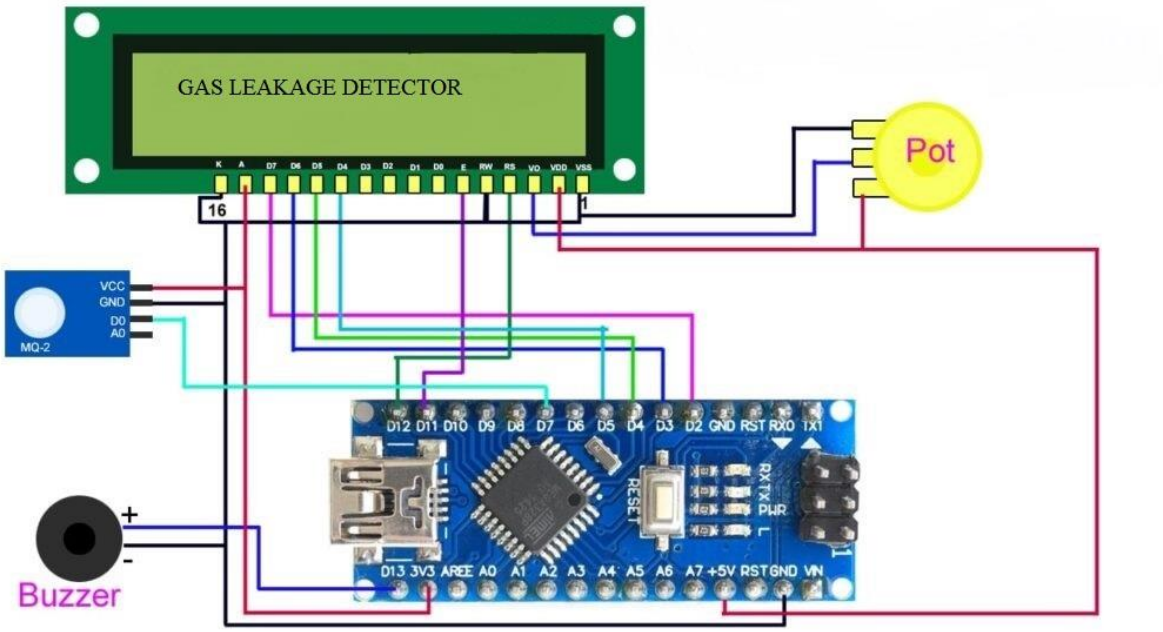
LCD LED K pin is connected to Arduino GND

Buzzer + is connected to Arduino pin D13 & buzzer (-) pin is connected to GND.

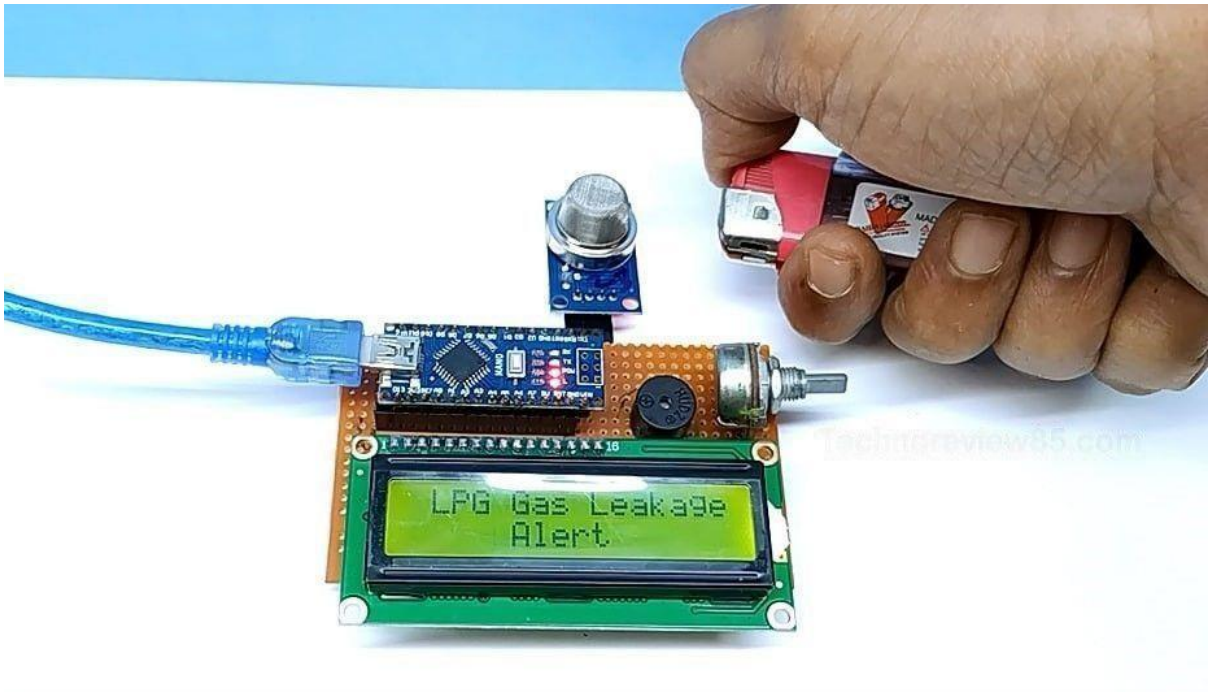
After making all the connections the final resulting system will resemble as below



Circuit diagram:-

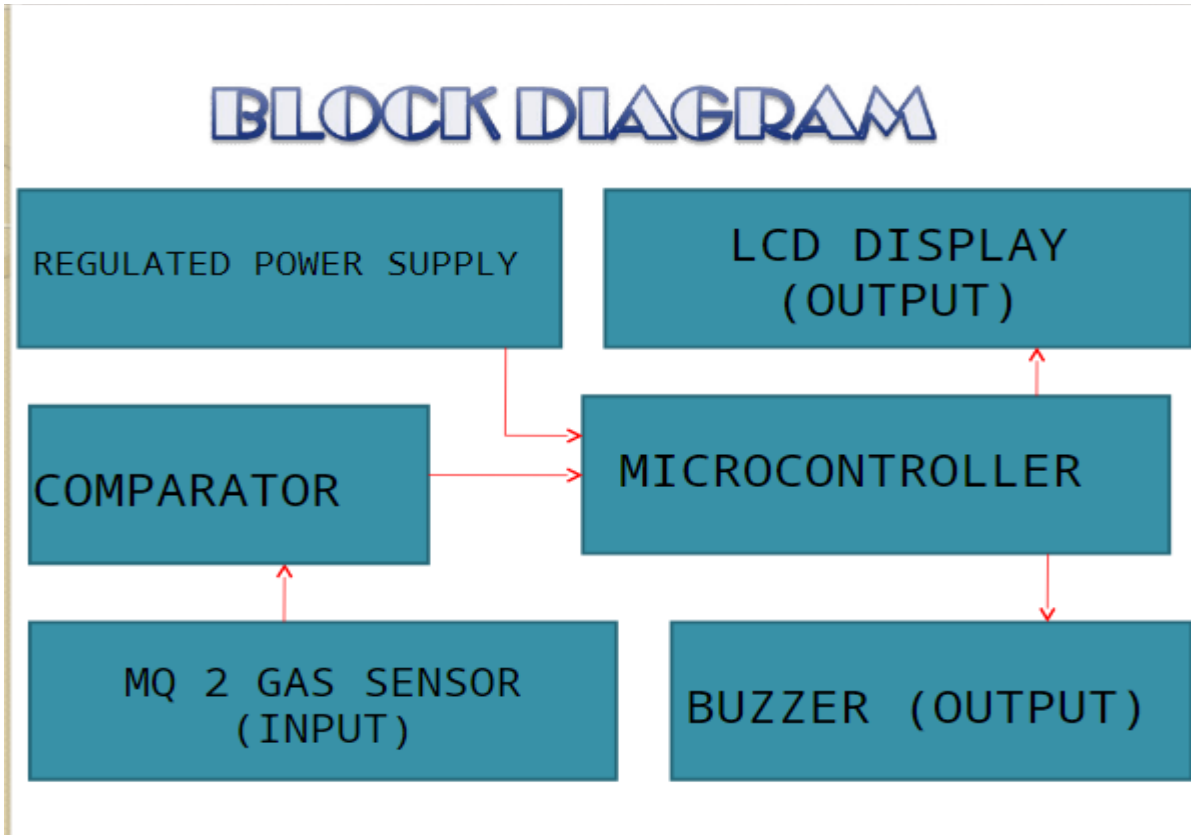


Working: -



When there is a Gas leak and then the mq2 sensor used in the circuit detects if LPG is present in the air & its D0 pin become high. D0 is connected to Arduino pin D7. According to code,

when the Arduino D7 pin gets high, the buzzer turns on & the LCD show" LPG Gas Leakage Alert ". If there is no gas leak then the "NO LPG GAS LEAK" alert is displayed.



LPG gas leakage detector Arduino code (Language C):-

```
#include <LiquidCrystal.h>
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

#define lpg_sensor 7
#define buzzer 13

void setup()
  {
     pinMode(lpg_sensor, INPUT);
     pinMode(buzzer, OUTPUT);
     lcd.begin(16, 2);
    lcd.print("LPG Gas Detector");
```

```
    lcd.setCursor(0,1);
    lcd.print("Techno Review 85");
    delay(2000);
}

void loop()
 {
    if(digitalRead(lpg_sensor))
      {
         digitalWrite(buzzer, LOW);
         lcd.clear();
         lcd.print("   NO LPG GAS   ");
         lcd.setCursor(0, 1);
         lcd.print("    LEAKAGE     ");
        delay(400);
        digitalWrite(buzzer, LOW);
        delay(500);
    }
  else
    {
      digitalWrite(buzzer, HIGH);
      lcd.clear();
      lcd.print(" LPG Gas Leakage ");
      lcd.setCursor(0,1);
      lcd.print("     Alert    ");
      delay(1000);
    }
}
```

Conclusion:-

After this project performance, can conclude that detection of the LPG gas leakage is incredible in the project system. Applicable usefully in the industrial and domestic purpose. In danger situations we are able to save the life by using this system. An alert is indicated by the GSM module. A sensor node senses gas like CO2, oxygen, propane. The estimated range of transmission and consumption of power is obtained. The simple procedures and Arduino UNO Micro controller area used to build the sensor.

The design of a sensor-based automatic gas leakage detector with an alert and control system has been proposed and discussed in this paper. This is a low-cost, low power, lightweight, portable, safe, user friendly, efficient, multi featured and simple system device for detecting gas. Gas leakage detection will not only provide us with significance in the health department but it will also lead to raise our economy, because when gas leaks it not only contaminates the atmosphere but also wastage of gases will hurt our economy. The proposed system will cost less and is also easily affordable even for poor people. In the open literatures it is noticed that much work has not been done for a smart gas detection system. In future, more advanced features will be integrated with this system which will provide users with more safety and relaxation. The proliferation of handheld devices has led to developments in the field of smart gas sensors, which has considerably widened their scope of application. The need for ensuring safety in workplaces is expected to be the key driving force for the market over the coming years.

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- **Arduino Project for Engineers-A Multipurpose Book for all Engineering Branches by Neerparaj Rai**