HOME AND INDUSTRIAL SAFETY USING FIRE/SMOKE/GAS TEMPERATURE DETECTOR SYSTEM

A Project
By

Md. Jahangir Alam	ME2103025499
Md. Sujon Ali	ME2103025369
Shakil Hasan	ME2103025385
Md . Ariful Islam	BME1903019067

Department of Mechanical Engineering
Sonargaon University (SU)
Dhaka-1215, Bangladesh

May, 2025

HOME AND INDUSTRIAL SAFETY USING FIRE/SMOKE/GAS TEMPERATURE DETECTOR SYSTEM

Submitted by

Md. Jahangir Alam	ME2103025499
Md. Sujon Ali	ME2103025369
Shakil Hasan	ME2103025385
Md . Ariful Islam	BME1903019067

Supervised By

Prof. Md. Mostofa Hossain

Head

Department of ME

SUBMITTED TO THE:

Department of Mechanical Engineering

SONARGAON UNIVERSITY (SU)

In partial fulfillment of the requirement for award of the degree

Of

Bachelor of Science in Mechanical Engineering

May, 2025

DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University Organization for award of any degree or certificate

We hereby ensure that the works that has been prevented here does not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligation.

[Authors]

Md. Jahangir Alam
ME2103025499

Md. Sujon Ali
ME2103025369

Shakil Hasan
ME2103025385

Md . Ariful Islam
BME1903019067

ACKNOWLEDGEMENT

First, we started in the name of almighty Allah. This thesis is accomplished under the supervision of Prof. Md. Mostofa Hossain, Head, Department of Mechanical, Sonargaon University. It is a great pleasure to acknowledge our profound gratitude and respect to our supervisor for this consistent guidance, encouragement, helpful suggestion, constructive criticism and endless patience through the progress of this work. The successful completion of this thesis would not have been possible without his persistent motivation and continuous guidance.

The author are also grateful to **Md. Mostofa Hossain**, Head of the Department of Mechanical Engineering and all respect teachers of the Mechanical Engineering Department for their co-operation and significant help for completing the thesis work successfully.

[Authors]

Md. Jahangir Alam
ME2103025499

Md. Sujon Ali
ME2103025369

Shakil Hasan
ME2103025385

Md . Ariful Islam
BME1903019067

ABSTRACT

Home and industrial safety systems are essential for preventing accidents, protecting lives, and securing property. These systems rely on traditional safety measures such as fire alarms, gas leak and Smoke detectors, emergency shutoff mechanisms, and surveillance systems. In homes, safety devices like smoke detectors, fire extinguishers, circuit breakers, and secure locking systems help prevent hazards. Industrial safety systems include fire suppression equipment, emergency exits, hazardous gas detectors, and mechanical safety interlocks to ensure worker protection. Manual monitoring, routine maintenance, and strict adherence to safety protocols play a crucial role in maintaining a secure environment. Proper ventilation, safety barriers, and clear emergency procedures further enhance safety standards. The integration of these conventional safety measures ensures effective risk management and minimizes potential dangers in both residential and industrial settings. Continuous improvements in design and compliance with safety regulations are necessary to enhance overall safety and create a more secure living and working environment.

Keyword: Home and Industrial Safety, Sensors, Display, Micro-Controller.

LIST OF ABBREVIATIONS

PCB	Printed Circuit Board
SMPS	Switch Mood Power Supply
AC	Alternating Current
DC	Direct Current
USB	Universal Serial Bus
Tx	Transmitter
Rx	Receiver
JU	Jahangirnagar University
LCD	Liquid Crystal Display
EDA	Electronic Design Automation
IDE	Integrated Development Environment
MQ	Metal Oxide

LIST OF FIGURES

Figure

1.1 Project Implement Chart 3
3.1 Block Diagram of our project 8
3.2 Circuit Diagram of our project 9
4.1 Arduino Nano 12
4.2 Arduino Nnao Schematic Diagram 12
4.3 How Arduino Nano Looks Like 13
4.4 Micro Controller IC AT mega 328p 14
4.5 SMPS 15
4.6 SMPS Circuit 16
4.7 SMPS Circuit Connection 18
4.8 DC Power Supply Way 18
4.9 16*2 LCD display 19
4.10 Pin out of 16*2 LCD display 19
4.11 16*2 LCD display Interfacing with Ardunino 20
4.12 DHT11 Temperature Sensor 21
4.13 Flame Senosr 21
4.14 MQ2 Gas Sensor 22
4.15 Buzzer 24
4.16 Arduino Software Interface IDE 26
4.17 Easy EDA Software Interface 29
5.1 Our Final Project 31

TABLE OF CONTENTS

DECLERATION vii
ACKNOWLEDGEMENTS vii
ABSTRACT viiv
LIST OF ABBREVIATION v
LIST OF FIGURES vi

CHAPTER

1. Introduction 1-4
1.1 Overview 1
1.2 Problem Statement 2
1.3 Objectives 2
1.4 Implementation Chart 3
1.5 Methodology 3
1.6 Research Outline 4

2. Literature Review 5-7
2.1 Introduction 5
2.2 Literature Review 5
2.3 Summary 7

3. System Architecture 8-10
3.1 Introduction 8
3.2 Block Diagram 8
3.3 Circuit Diagram 9
3.4 Working Principle 9
3.5 Cost Analysis 10

4. Hardware and Software Analysis 11-29
4.1 Introduction 11
4.2 Hardware & Software 11
4.3 Arduino Nano 11
4.4 SMPS 14

4.5 LCD Display 19
4.6 Temperature Sensor 20
4.7 Flame Sensor 21
4.8 Gas Sensor 22
4.9 Buzzer 24
4.10 Arduino IDE 25
4.10 Easy EDA 29

5. Result Analysis 30-32
5.1 Result Analysis 30
5.2 Complete Project Prototype 31
5.3 Advantages 31
5.4 Application 32
5.5 Limitation 32
5.6 Discussion 32

6. Future Work and Conclusion 33
6.1 Conclusion 33
6.2 Future Scope of Work 33

References 34
Appendix 36

CHAPTER 1
Introduction

1.1 Overview

In today's world, safety is a top priority when it comes to designing and constructing residential, commercial, and industrial spaces, as well as entire cities.Unfortunately, each year, numerous individuals lose their lives in accidents caused by gas cylinder explosions or fires, whether at home, in industries, or elsewhere. These tragic incidents often result from the lack of knowledge and proficiency in handling gas among a significant number of users. Gas-related accidents have become a pressing concern from various perspectives, including technical, economic, and agricultural domains. Additionally, gas leaks from natural gas pipelines pose a serious threat, as they can lead to fires that endanger human lives. Moreover, toxic gas leaks contribute to environmental pollution, posing risks to both humans and other species. Fire accidents, on the other hand, continue to pose a significant danger to human life, with incidents such as cylinder and chemical explosions being major causes of fires in Bangladesh. Disturbingly, in a single year, these accidents led to the injury of nearly fifty individuals and claimed the lives of ten due to gas cylinder blasts and fire outbreaks . Given the severity of these fire incidents and gas-related accidents, there is a growing focus on developing new technologies aimed at minimizing these risks. Several systems have been implemented to detect gas leaks and fire occurrences. However, many of these existing solutions face constraints, such as inefficiency in the utilization of financial resources, space, and time. In light of these challenges, our project offers several advantages:

- Real-life applicability, providing practical and cost-efficient solutions
- Accurate and reliable information
- Simplified circuitry, reducing complexity
- No adverse environmental or physical impact

The primary objective of our project is to address the detection of LPG gas, which is often the cause of fire incidents, as well as to detect the occurrence of fires and the flow of smoke. In situations where gas leaks or fires arise, people may not immediately recognize the gravity of the situation. However, an increase in temperature accompanies these events,

which poses health risks to humans and detrimentally impacts the environment.Through our project, we aim to contribute to the mitigation of these risks by developing a practical and cost-effective solution. By accurately sensing gas leaks, fire occurrences, and smoke, our system aims to provide timely warnings and alerts to ensure the safety of individuals and their surroundings. By addressing the limitations of existing systems, we strive to create a reliable and efficient solution that effectively minimizes the harmful impacts of gas leaks and fire incidents.

1.2 Problem Statement

Accidents and hazards in homes and industries pose significant risks to human life, property, and productivity. Common threats such as fires, gas leaks, electrical faults, and unauthorized access can lead to severe consequences, including injuries, financial losses, and operational disruptions. Despite the availability of conventional safety measures like gas detectors, and surveillance systems, many homes and industrial facilities still experience safety failures due to a lack of proper implementation, maintenance, or human oversight. Additionally, the absence of a well-integrated and efficient safety system increases response time during emergencies, leading to greater damage.This project aims to develop a robust safety system using traditional safety mechanisms to improve protection, minimize risks, and ensure a safer environment in both residential and industrial settings.

1.3 Objectives

The objectives of this project:

- To study of the Home and Industrial safety System.
- To design and construct of a temperature, fire ,gas and Smoke detection system.
- To develop a reliable safety system for homes and industries to prevent accidents caused by smoke , fire and gas leaks.
- To implement and study of take proper step to reduce these incident.
- To put the whole system into action so that we can observe its practical effects and verify our work.
- To study the system performance for future reference and improvement purpose.

1.4 Implementation Chart

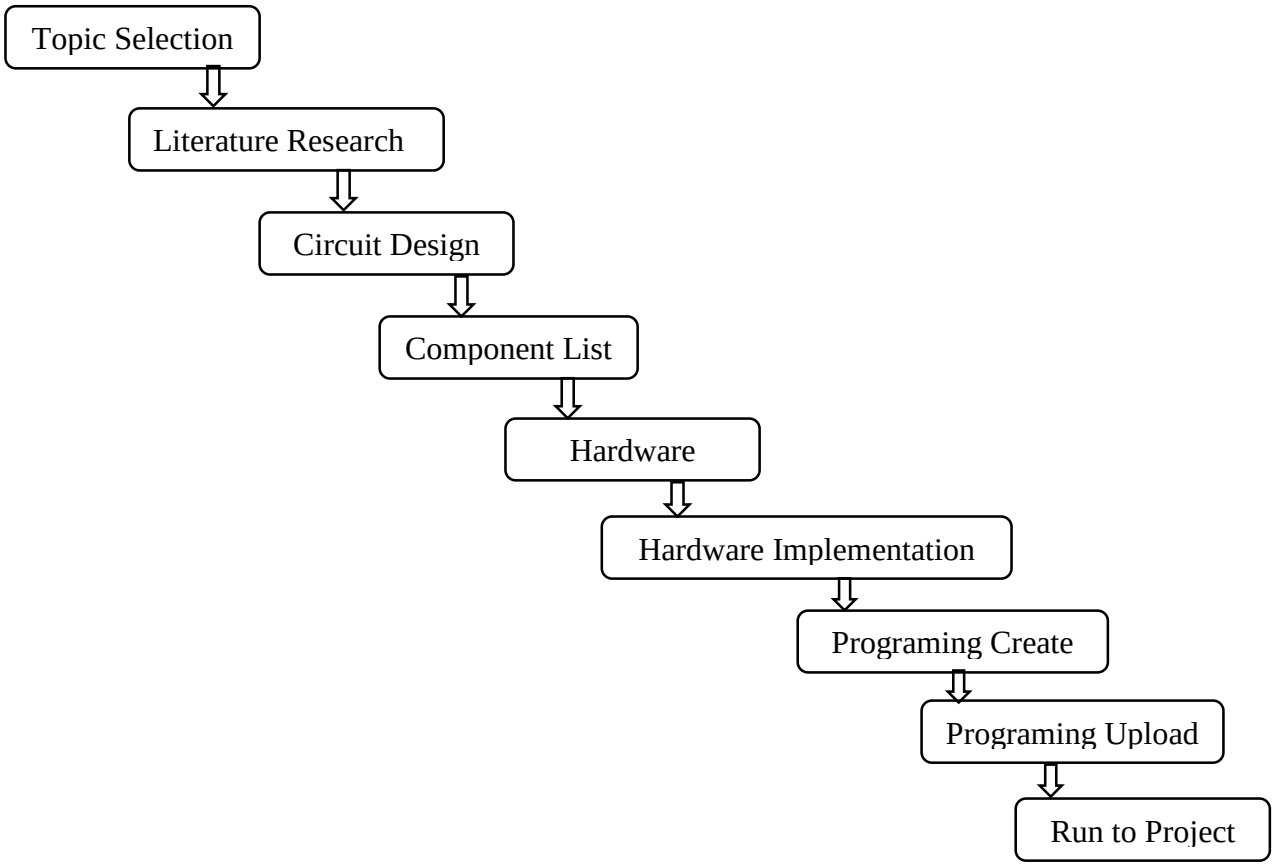


Figure 1.1 Project Implement Chart

1.5 Methodology

Our methodologies for the project:

- Creating an idea for design and construction of an Home and Industrial safety System. And designing a block diagram & circuit diagram to know which components we need to construct it.
- Collecting all the components and programming the micro controller to control the whole system.
- Setting up all the components in a PCB board & then soldering. Lastly, assembling all the blocks in a board and to run the system & for checking purposes.

1.6 Research Outline

This project book consists of Six chapter. The first chapter contains the statement of the introduction,Problem Statement, Implementation Chart, objectives of the study and Methodology. Chapter two contains system Literature Review details. Chapter three Discussed in Block Diagram,Circuit Diagram,Working principle and Cost analysis.Chapter Four describes the hardware implementation with component details and the software which we have used for our work. Chapter Five deals with the result Analysis,shows the complete prototype,Advantage, Application and Limitation of the project that we have built. In the final chapter, we have discussed the , Future Scope, conclusion of the project.

CHAPTER 2

Literature Review

2.1 Introduction

In this chapter we discuss our system overview. In this paper they also work about Home and Industrial safety System. In below section we will describe some previous literature review. From previous literature we gather more knowledge to build this project and we successfully made it .

2.2 Literature Review

S. Tseng et al [1] proposed smart house monitor and manager (SHMM) system based on the ZigBee. In this work all sensors (gas and flame sensors) and actuators are connected by a ZigBee wireless network. They designed a simple smart socket, which can remotely control via ZigBee. PC host is used as a data collector and the motion sensing, all sensing data are transferred to the virtual machine in the cloud. The user can use the PC or Android phone to monitor or control through the Internet to power-saving of the house.

Bhattacharjee et al [2] designed a system entitled “Design and Development of a Flexible Reliable Smart Gas Detection System”. This system composed of three modules; the base station, wireless sensor array and an intelligent wireless alarm unit, which offers high reliability, flexibility and uninterrupted sensing. These are achieved by incorporating various intelligent protocols like auto sensor calibration, sensor handover, wireless threshold fixation and intelligent alarm mechanism. The sensor node consists of three gas sensors, one temperature sensor and one pyro-electric infrared sensor (PIR) which enhances the sensing intelligence. The sensed data are digitized and processed by the peripheral interface controller (PIC) 16f877A based centralized embedded platform and wireless communication is achieved with a pair of 433 and 315 MHz amplitude shift keying(ASK) wireless module. The encoding and decoding of sensed data offer a high secured gas detection system.

A low cost automotive localization system using GPS and GSM-SMS services was proposed by I. Lita et al. [3] It is concerning “A New Approach of Automatic Localization System Using GPS and GSM/GPRS Transmission”, which provides the position of the

vehicle on the driver’s or owner’s mobile phone as a short message (SMS). The system can be interconnected with the car alarm system that alerts the owner, on his mobile phone, about the events that occurs with his car when it is parked. The system is composed by a GPS receiver, a microcontroller and a GSM phone. In addition, the system can be settled for acquiring and transmitting the information, whenever requested about automobiles status and alerts the user about the vehicle’s started engine.

Y. P Tsang, K. L. Choy [4] propounded the IoT model to ensure occupational health and safety, the limited duration exposure and monitoring review cycle can be customized according to the personal health status of worker. In order to ensure the occupational health and safety in cold storage facilities, the IoT environment is essential to develop the appropriate occupational safety management with real time information exchange and information. A paper by Kartik Srinivas [5] in which he implemented industrial safety automation using IoT by successfully integrating industry safety to the digital World.

Tanvira Ismail et al. [6] A GSM-based gas leakage warning system was proposed in a previous study. The concept involved utilizing an MQ-6 gas sensor to detect the presence of gas in the atmosphere. Once gas was detected, a signal was transmitted to the microcontroller's ADC unit. The microcontroller, in turn, activated various external devices connected to it, such as a buzzer, GSM module, and exhaust fan. This system aimed to provide timely alerts and take necessary actions in response to gas leaks.

In another research endeavor, the objective was to develop a gas monitoring system with an automatic cylinder booking feature for home usage. The researchers employed an MQ-4 gas sensor to detect gas leakage. Upon detection, the data was transmitted to an LCD monitor, a buzzer, and the authorities' mobile phones through a GSM module. Additionally, an automatic cylinder booking system was incorporated into the design, utilizing a load cell for the purpose. Overall, these studies focused on leveraging gas sensors, microcontrollers, and GSM modules to create effective gas monitoring systems. The proposed systems aimed to detect gas leakage, alert users through various means such as buzzers and LCD monitors, and even enable automatic cylinder booking for improved convenience and safety.[7]. A system is designed to detect the gas leakage and make a smart alert system through email and message alert to the phone using the GSM module [8].

Pavithraa.M et al. [9] discussed about IoT based LPG gas booking and monitoring system. They used load cell, IoT(Internet of Things), Global Posting System(GPS). A. Mahalingam et al. [10] have discussed about design and implementation of an economic gas leakage detector. Fraiwan et al. [11] In their system, the researchers utilized a gas detection and transmission module along with a receiver module, forming a wireless network. They developed a dedicated sensing circuit designed specifically for gas detection, establishing a predefined threshold value for gas concentration. When the concentration of gas exceeded this threshold value, the sensing circuit promptly detected it, triggering an alarm and sending a signal to the RF receiver. Faisal et al. [12] has established a system where multiple gas sensors detect the leakage gas and sends a message to two different phone numbers and LCD monitorand makes an alarm. A system is proposed where fire sensor, temperature and humidity sensor, and wireless senor network have used for monitoring the fire detection node [13]. A system is analyzed to establish a numerical formula for combustible gas spread in housing and industrial area [14].

Chen et al. [15] proposed a system where the smoke can be detected by video processing created by fire. They used the chromatic decision rule and dynamic decision rule in their method. Abdullah-Al Nahid et al. [16] designed a simple system by which liquid leakage in supply can be detected simply. That design is cost effective and included both flow measurement, data storing and monitoring.

2.3 Summary

From the literature discussed above, we gained a lot of knowledge and we inspired to do this project. We were able to do it with everyone tireless work.

CHAPTER 3

System Architecture

3.1 Introduction

The project objectives, methods, literature evaluation, and other details were all clarified in the preceding chapter. The block diagram, circuit diagram, Working principle, and final project instrument cost analysis will all be covered in this chapter.

3.2 Block Diagram

Here is the block diagram of the **Home and Industrial safety System** with all the essential components. All of the components are shown in below as a block in this diagram.Here we use Arduino Nano for main brain of our project. Other equipment's are attached with this micro-controller and work together for perform as our desire outcome.

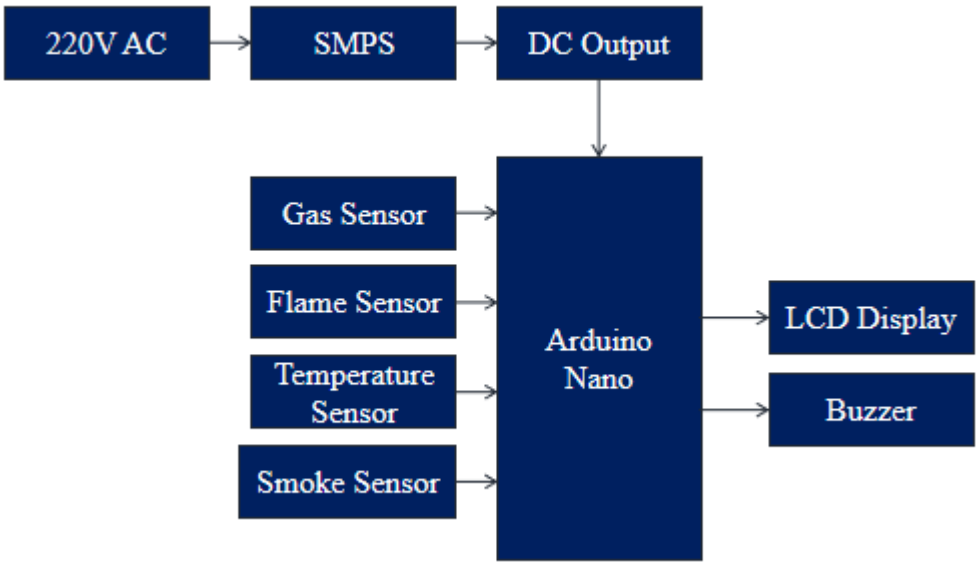


Figure 3.1: Block Diagram of Our Project

3.3 Circuit Diagram

In this part we show our project circuit design and connect out instrument through standard wire.

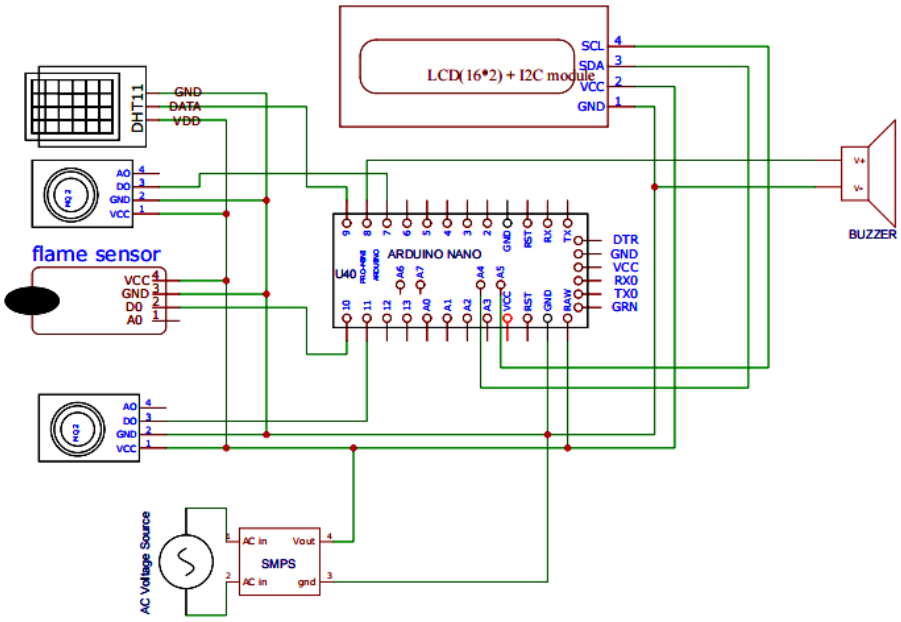


Figure 3.2: Circuit Diagram of Our Project

3.4 Working Principle

The home and industrial safety system operates by continuously monitoring environmental parameters using various sensors and triggering alerts when hazards are detected. The SMPS (Switched Mode Power Supply) provides a stable DC voltage to power the system components efficiently. The Arduino Nano serves as the central controller, processing sensor data and activating safety responses.

The gas sensor detects harmful gas leaks and sends data to the Arduino, which then displays a warning message on the LCD. The flame sensor identifies fire outbreaks, and the smoke sensor detects smoke presence, both updating the display with alerts. The temperature sensor monitors heat levels, ensuring early detection of overheating conditions. When any hazard is detected, the system triggers the buzzer alarm system, providing an immediate audible warning to alert nearby individuals.

The LCD display provides continuous updates on environmental status, and the buzzer enhances safety by ensuring rapid awareness of potential dangers.

3.5 Cost Analysis

Table 1:List of Component with Price

Sl.no	Particulars	Specification	Qty.	Unit Price (Taka)	Total Price (Taka)
1	SMPS	5V	1	650	650
2	Arduino Nano	IC AT mega328p	1	600	600
3	Flame Sensor		1	250	250
4	Gas Sensor	MQ 2	1	300	300
5	Smoke Sensor	MQ5	1	300	300
6	Temperature Sensor	DHT11	1	300	300
7	LCD Display	16*2	1	400	400
8	Buzzer		1	50	50
9	Others				1000
				Total	3850/=

CHAPTER 4

Hardware and Software Analysis

4.1 Introduction

In this section, we will discuss elaborately about "**Home and Industrial safety System**" and the component description, features, working procedure of our all equipment.The system hardware fabricates composed of micro-controller unit, power unit, source unit, power store unite, sensor unit and many more related components.

4.2 Hardware & Software

Hardware

- Arduino Nano
- SMPS
- Gas Sensor
- Smoke Sensor
- Temperature Sensor
- Flame Sensor
- LCD Display
- Buzzer

Software

- Arduino Software
- Easy EDA

4.3 Arduino Nano

Arduino is open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling Lights, motors, and other actuators.

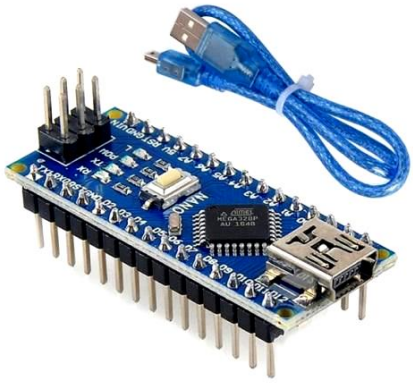


Figure 4.1: Arduino Nano

The micro-controller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, Maxims'). Arduino Nano is a surface mount breadboard embedded version with integrated USB. It is a small, complete, and breadboard friendly component. It has everything that Decimal/ Duemilanove has (electrically) with more analog input pins and onboard +5V AREF jumper. Physically, it is missing power jack. The Nano can automatically sense and switch to the higher potential source of power.

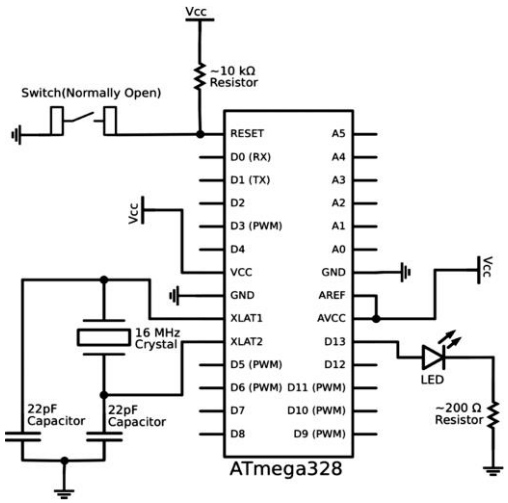


Figure 4.2: Arduino Nano Schematic Diagram

Nano's got the breadboard-ability of the Boarding and the Minibus with smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, and GND on one top, power and ground on

the other). This new version 3.0 comes with ATMEGA328 which offer more programming and data memory space. It has two layers. That make it easier to hack and more affordable. One of the best features of Arduino Nano is, it's easy to use, compact and also small.

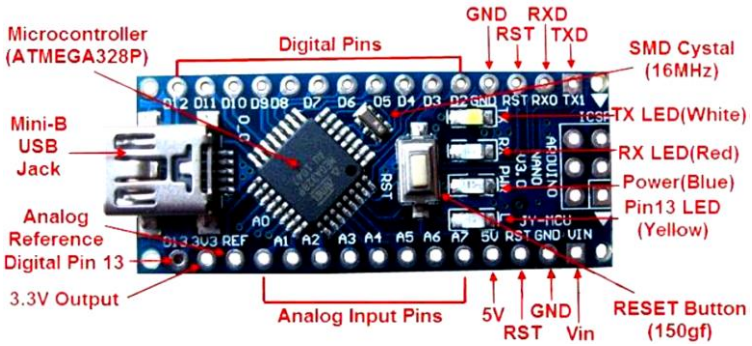


Figure 4.3: How Arduino Nano looks like

Specifications

- Micro-controller: Atmel ATmega328
- Operating Voltage (logic level): 5 V
- Input Voltage (recommended): 7-12 V
- Input Voltage (limits): 6-20 V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA
- Flash Memory: 32 KB (of which 2KB used by boot loader)
- SRAM : 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Dimensions: 0.70" x 1.70"

Features

- Automatic reset during program download
- Power OK blue LED
- Green (TX), red (RX) and orange (L) LED
- Auto sensing/switching power input

- Small mini-B USB for programming and serial monitor
- ICSP header for direct program download
- Manual reset switch

Micro-controller IC ATmega328p



Figure 4.4: Micro-controller IC AT mega 328p

The high-performance Microchip Pico Power 8-bit AVR RISC-based micro-controller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, a 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughput's approaching 1 MIPS per MHz, balancing power consumption and processing speed.

4.4 Switch Mode Power Supply (SMPS)

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics. Unlike a linear power supply, the pass

transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.



Figure 4.5: SMPS

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor. Switched-mode power supplies are classified according to the type of input and output voltages. The four major categories are:

- AC to DC
- DC to DC
- DC to AC
- AC to AC

A basic isolated AC to DC switched-mode power supply consists of:

- Input rectifier and filter
- Inverter consisting of switching devices such as MOSFETs

- Transformer
- Output rectifier and filter
- Feedback and control circuit

The input DC supply from a rectifier or battery is fed to the inverter where it is turned on and off at high frequencies of between 20 KHz and 200 KHz by the switching MOSFET or power transistors. The high-frequency voltage pulses from the inverter are fed to the transformer primary winding, and the secondary AC output is rectified and smoothed to produce the required DC voltages. A feedback circuit monitors the output voltage and instructs the control circuit to adjust the duty cycle to maintain the output at the desired level.

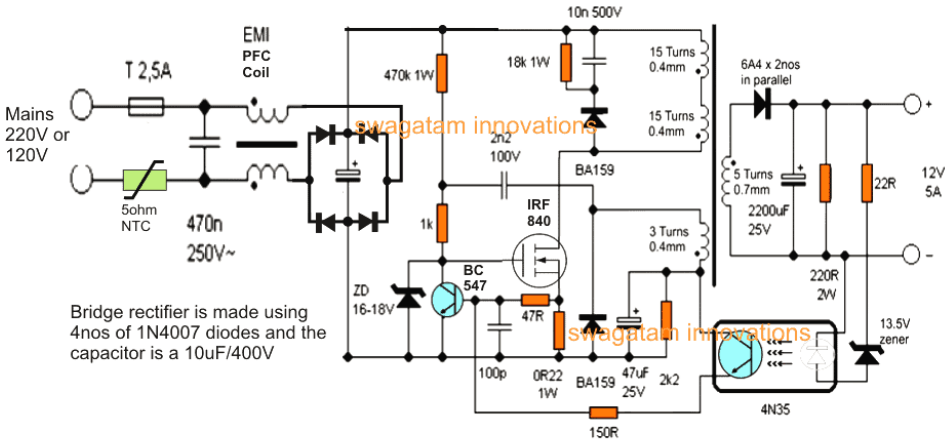


Figure 4.6: SMPS Circuit

Basic working concept of an SMPS

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level.

Design basics

AC power first passes through fuses and a line filter. Then it is rectified by a full-wave bridge rectifier. The rectified voltage is next applied to the power factor correction (PFC) pre-regulator followed by the downstream DC-DC converter(s). Most computers and small appliances use the International Electrotechnical Commission (IEC) style input

connector. As for output connectors and pin outs, except for some industries, such as PC and compact PCI, in general, they are not standardized and are left up to the manufacturer.

There are different circuit configurations known as topologies, each having unique characteristics, advantages and modes of operation, which determines how the input power is transferred to the output. Most of the commonly used topologies such as flyback, push-pull, half bridge and full bridge, consist of a transformer to provide isolation, voltage scaling, and multiple output voltages. The non-isolated configurations do not have a transformer and the power conversion is provided by the inductive energy transfer.

Advantages of switched-mode power supplies

- Higher efficiency of 68% to 90%
- Regulated and reliable outputs regardless of variations in input supply voltage
- Small size and lighter
- Flexible technology
- High power density
- Disadvantages:
- Generates electromagnetic interference
- Complex circuit design
- Expensive compared to linear supplies

Switched-mode power supplies are used to power a wide variety of equipment such as computers, sensitive electronics, battery-operated devices and other equipment requiring high efficiency. Linear voltage IC regulators have been the basis of power supply designs for many years as they are very good at supplying a continuous fixed voltage output. Linear voltage regulators are generally much more efficient and easier to use than equivalent voltage regulator circuits made from discrete components such a zener diode and a resistor, or transistors and even op-amps.The most popular linear and fixed output voltage regulator types are by far the 78… positive output voltage series, and the 79… negative output voltage series.

These two types of complementary voltage regulators produce a precise and stable voltage output ranging from about 5 volts up to about 24 volts for use in many electronic circuits.There is a wide range of these three-terminal fixed voltage regulators available

each with its own built-in voltage regulation and current limiting circuits. This allows us to create a whole host of different power supply rails and outputs, either single or dual supply, suitable for most electronic circuits and applications. There are even variable voltage linear regulators available as well providing an output voltage which is continually variable from just above zero to a few volts below its maximum voltage output.

Switch Mode Power Supply

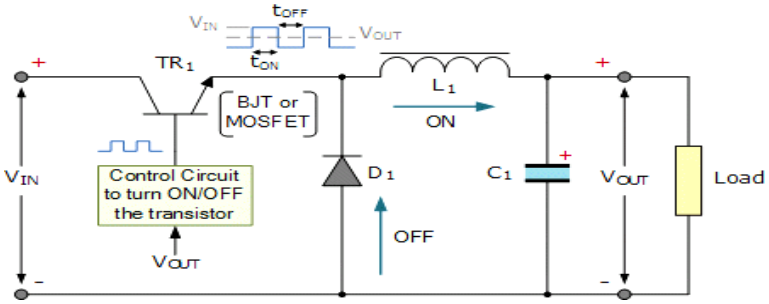


Figure 4.7: SMPS Circuit Connection

Most d.c. power supplies comprise of a large and heavy step-down mains transformer, diode rectification, either full-wave or half-wave, a filter circuit to remove any ripple content from the rectified d.c. producing a suitably smooth d.c. voltage, and some form of voltage regulator or stabiliser circuit, either linear or switching to ensure the correct regulation of the power supplies output voltage under varying load conditions. Then a typical d.c. power supply would look something like this:

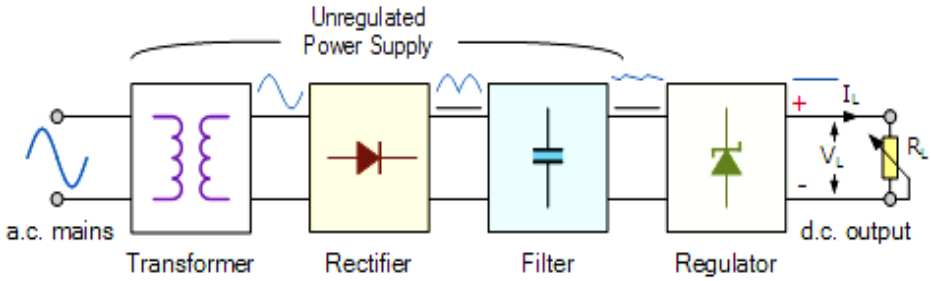


Figure 4.8: DC Power supply way

These typical power supply designs contain a large mains transformer (which also provides isolation between the input and output) and a dissipative series regulator circuit. The regulator circuit could consist of a single zener diode or a three-terminal linear series

regulator to produce the required output voltage. The advantage of a linear regulator is that the power supply circuit only needs an input capacitor, output capacitor and some feedback resistors to set the output voltage.

4.5 LCD Display

The LCD (liquid crystal display) screen is an electronic display module and looks for various applications. A 16x2 LCD display is a very basic module and it is very commonly used in various devices and circuits. These modules are preferred over seven sections and many other segments.

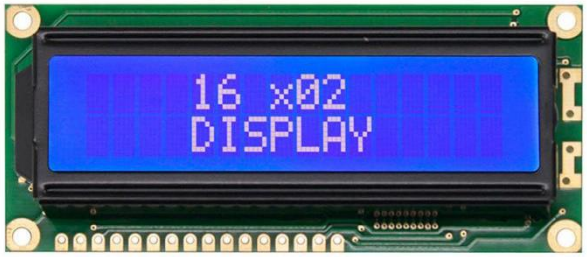


Figure 4.9: 16*2 LCD Display

The reasons for having LCD are economic; Easily programmable, special and even custom characters (different in seven sections), there are no restrictions on displaying animations. A 16x2 LCD means it can display 16 characters per line and contains 2 lines. Each character on this LCD is displayed in a 5x7 pixel matrix.

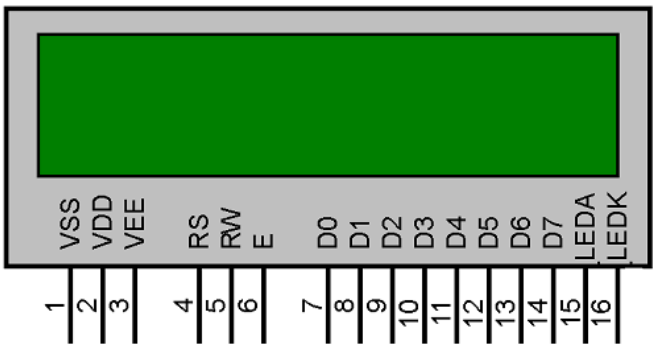


Figure 4.10: Pin out of 16*2 LCD Display

This LCD contains two articles called Command and Data. The command register stores the command instructions on the LCD. The command is a command given to the LCD to

perform a predefined task such as starting it, clearing its screen, locating the cursor, controlling the display, etc.

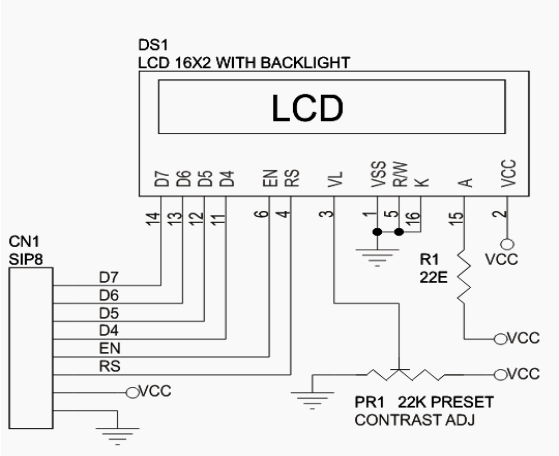


Figure 4.11: 16*2 LCD Display interfacing with Arduino

Feature

The features of this LCD mainly include the following.

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters

4.6 Temperature Sensor

The DHT11 is a basic, ultra-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.

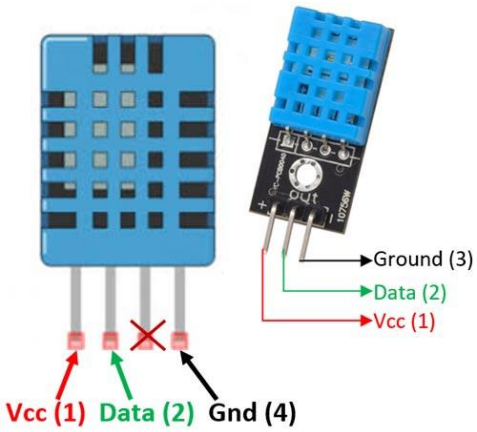


Figure 4.12: DHT11 Temperature Sensor

DHT11 Specifications

- Operating Voltage: 3.5V to 5.5V
- Operating current: 0.3mA (measuring) 60uA (standby)
- Output: Serial data
- Temperature Range: 0°C to 50°C
- Humidity Range: 20% to 90%
- Resolution: Temperature and Humidity both are 16-bit
- Accuracy: ±1°C and ±1%

4.7 Flame Sensor

The flame sensor can detect flame and infrared light sources with wavelengths ranging from 760 nm to 1100 nm. It uses the LM393 comparator chip, which gives a clean, stable digital output signal and driving ability of 15 mA. This flame detector that can be used in fire alarms and other fire detecting devices.

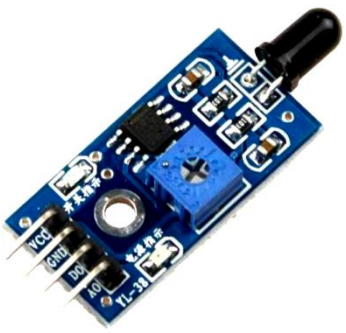


Figure 4.13: Flame Sensor

Specifications

- LM393 comparator chip
- Detection Range: 760 nm to 1100 nm
- Operating Voltage: 3.3 V to 5 V
- Maximum Output Current: 15 mA
- Digital Outputs: 0 and 1
- Detection Angle: about 60 degrees
- Adjustable sensitivity via potentiometer
- LED lights indicators: power (red) and
- digital switching output (green)
- Fixed bolt holes for easy installation
- PCB Size: 32 x 14 mm

4.8 Gas Sensor

The utility model can be used for gas leakage monitoring devices in families and factories, and is suitable for the detection of liquefied petroleum gas, butane, propane, methane, Hydrogen, smoke, etc. This is a very easy to use low cost semiconductor Gas sensor Module with analog and digital output.



Figure 4.14: MQ2 Gas Sensor

Features

- Adopt high quality double panel design, with power indication and TTL signal output indication.
- It has DO switch signal (TTL) output and AO analog signal output.
- TTL output valid signal is low level. When the output is low, the signal light is on, and the micro-controller or relay module can be directly connected.
- The analog output voltage increases with the concentration, the higher the voltage.

- It has better sensitivity to liquefied petroleum gas, natural gas, urban gas and smoke.
- MQ-2 MQ2 Smoke Gas LPG Butane Methane Sensor Detector Module
- With four screw holes, easy to locate.
- Product size: 32 (L), *20 (W), *22 (H)
- With long service life and reliable stability.
- Fast response recovery features

Specifications

- Input voltage: DC5V
- Power dissipation (current): 150mA
- DO output: TTL, numeric quantities 0 and 1 (0.1 and 5V)
- AO output: 0.1-0.3V (relatively pollution-free), the highest concentration of about 4V voltage
- Special reminder: after the sensor is energized, you need to preheat 20S or so, the data to be stable, sensor heating is a normal phenomenon, because the internal heating wire, if hot, it is not normal.

Connection mode

- VCC: power supply positive (5V)
- GND: power supply negative pole
- DO:TTL switch signal output
- AO: analog signal output
- Functions: This version supporting test procedures
- Using chips: AT89S52
- Crystal oscillator: 11.0592MHZ
- Since this Gas Sensor module is sensitive to smoke it can be used in for fire detection. MQ2 Gas Sensor is also sensitive to flammable/combustible gasses like LPG, Propane & Hydrogen.
- Baud rate: 9600

4.9 Buzzer

Piezo elements are actually one of the coolest crystals you'll play with. Flex them, they generate a voltage (pretty high, actually). Pass power through them, and they'll flex. Do it fast enough, and they'll start to make a sound! So besides making annoying little `beep` noises, you could use it as a sensor to detect a knock or other similar vibration.



Figure 4.15: Buzzer

Specifications

- Operating Voltage: 1.0 ~ 20.0V
- Rated Voltage: 3.0V
- Diameter: Ø12.5mm
- Total Height: 6.3mm
- Capacitance: 15,000pF
- Current Consumption: ≤2mA
- Resonance Frequency: 4,000Hz
- Sound Pressure Level at 10cm: ≥75db

SOFTWARE

4.10 Arduino IDE

The digital microcontroller unit named as Arduino Nano can be programmed with the Arduino software IDE. There is no any requirement for installing other software rather than Arduino. Firstly, Select "Arduino Nano from the Tools, Board menu (according to the microcontroller on our board). The IC used named as ATmega328 on the Arduino Nano comes pre burned with a boot loader that allows us to upload new code to it without the use of an external hardware programmer.

Communication is using the original STK500 protocol (reference, C header files). We can also bypass the boot loader and programs the microcontroller through the ICSP (In Circuit Serial Programming) header. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2. On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.The Arduino Nano is one of the latest digital microcontroller units and has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL at (5V) with serial communication, which is available on digital pins 0 -(RX) for receive the data and pin no.1 (TX) for transmit the data. An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an .in file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board.

The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial Communication on pins 0 and 1). A Software Serial library allows for serial communication on any of the Nano's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus. Arduino

programs are written in C or C++ and the program code written for Arduino is called sketch. The Arduino IDE uses the GNU tool chain and AVR Lab to compile programs, and for uploading the programs it uses argued. As the Arduino platform uses Atmel microcontrollers, Atmel's development environment, AVR Studio or the newer Atmel Studio, may also be used to develop software for the Arduino.

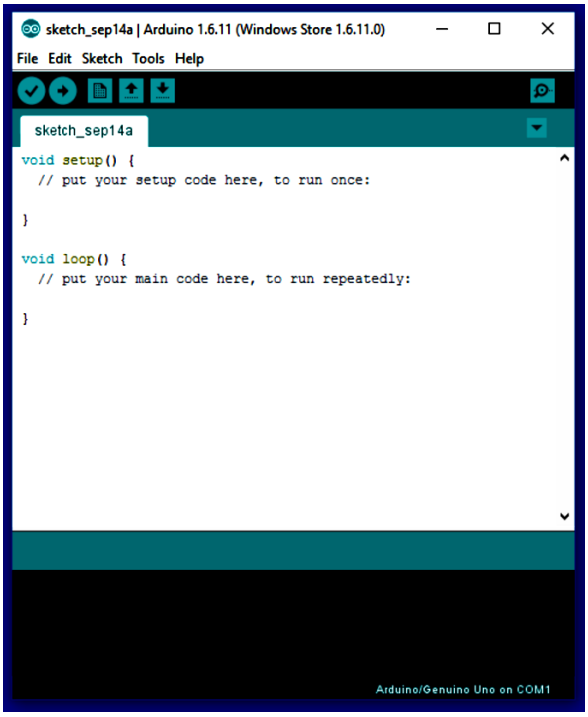


Figure 4.16: Arduino Software Interface IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port.

The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs (or sketches). The sketches in your sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time you run the Arduino software, it will automatically create a directory for your sketchbook. You can view or change the location of the sketchbook location from with the Preferences dialog. Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the .pde extension. You may still open .pde named files in version 1.0 and later, the software will automatically rename the extension to .ino.

Tabs, Multiple Files, and Compilation

Allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

Uploading

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx , /dev/ttyUSBx or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When you upload a sketch, you're using the Arduino bootloader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The bootloader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The bootloader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include statements from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

Third-Party Hardware

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

For details on creating packages for third-party hardware, see the Arduino IDE 1.5 3rd party Hardware specification.

Serial Monitor

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose

the baud rate from the drop-down menu that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board.

4.11 Easy EDA

Easy EDA is a web-based EDA tool suite that enables hardware engineers to design, simulate, share-publicly and privately-and discuss schematics, simulations and printed circuit boards. Other features include the creation of a bill of materials, Gerber files and pick and place files and documentary outputs in PDF, PNG and SVG formats. Easy EDA allows the creation and editing of schematic diagrams, SPICE simulation of mixed analogue and digital circuits and the creation and editing of printed circuit board layouts and, optionally, the manufacture of printed circuit boards.

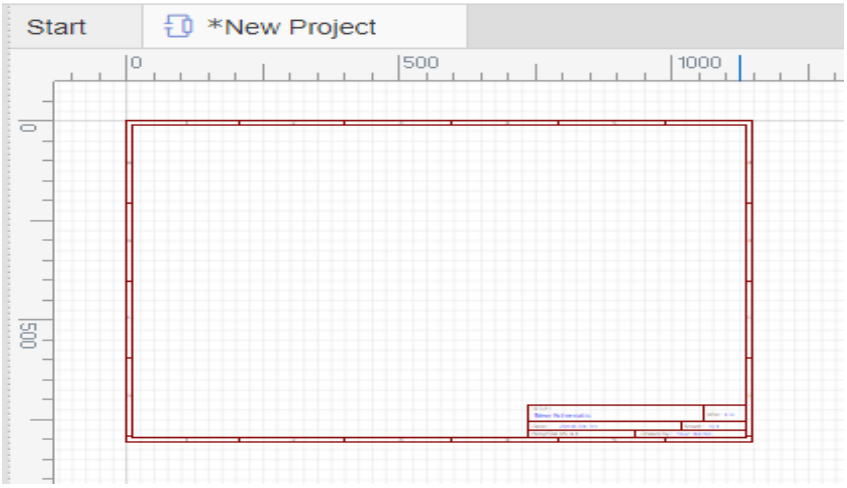


Figure 4.17: Easy EDA Software Interface

Subscription-free membership is offered for public plus a limited number of private projects. The number of private projects can be increased by contributing high quality public projects, schematic symbols, and PCB footprints and/or by paying a monthly subscription.Registered users can download Gerber files from the tool free of charge; but for a fee, Easy EDA offers a PCB fabrication service. This service is also able to accept Gerber file inputs from third party tools.

CHAPTER 5

Result Analysis

5.1 Result Analysis

After finally completing this project, we ran it & we observed the output of this project. We can see that it is working well as expected. After making our project we observe it very careful. It works as we desire. Our project give output perfectly and all equipment are work perfectly. We check how much it works and we get perfect output from this project.

- Finally, we have completed our project successfully & check our project its run accurately according to our objective.
- At first, we start our system.
- The gas and Smoke sensor accurately detects harmful gas leaks
- The flame sensor effectively identifies fire outbreaks, responding quickly to potential hazards.
- The temperature sensor reliably monitors heat levels, helping to prevent overheating incidents.
- The buzzer alarm provides quick audible warnings, enabling fast evacuation or response.
- The system consistently displays real-time data on the LCD, ensuring users stay informed.

5.2 Complete Project prototype

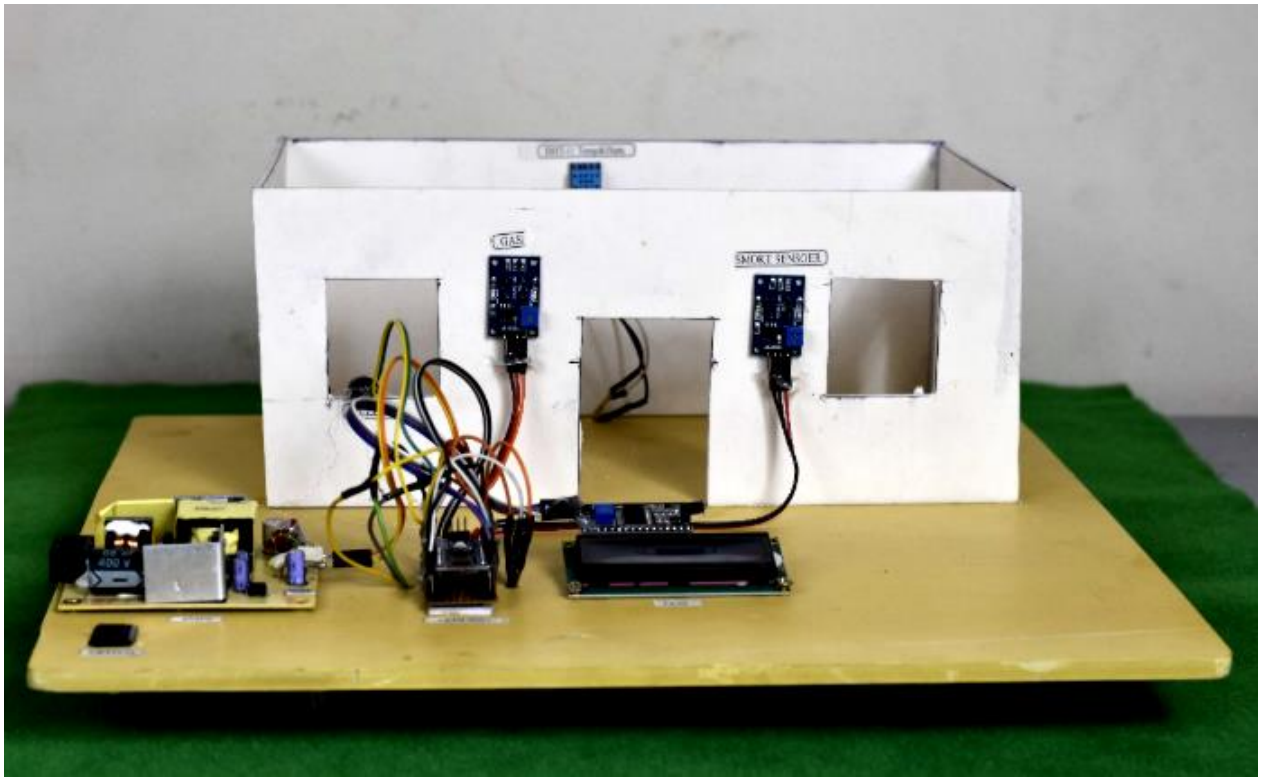


Figure 5.1:Our Final project

5.3 Advantages

There are certainly many advantages of our project and some of the major ones have been given below:

- Can measure the temperature of inside Home and industry.
- Can detect gas and fire incident automatically.
- Also real-time data show on the LCD Display.
- This project is easy to use
- Cost effective
- User-friendly
- Automatic and requires less human interaction
- Can be operated virtually from anywhere in the world
- The whole system consumes very little energy.

5.4 Application

The application areas for this project in this modern and practical world are huge and some of these are given below:

- It can be used in any educational institutions
- It can be used in any Home, industry or corporate offices
- It can be used in Hospitals
- It can be used in residential areas

5.5 Limitations

Through the project has many advantages it has also some limitation, they are given below:

- This project can now be only used for small scale purposes
- No energy backup.
- Used cheap Chinese products for the prototype so there's some processing delay present in the circuit.
- Sensor Range and Sensitivity

5.6 Discussion

While working on our project, we did face some difficulties as it is a very complex system but the end results, we came up with were quite satisfactory. We have put the whole system through several tasks to validate our work and also have taken necessary notes for future improvements. Some future recommendations that we have involves improvement in system design and wiring, adding features for more efficient.

The Home and Industrial Safety System effectively enhances safety by continuously monitoring environmental hazards such as gas leaks, fire outbreaks, smoke presence, and overheating. With its integration of sensors and real-time alert mechanisms, the system ensures rapid detection and response, minimizing potential damage and safeguarding lives. The use of an Arduino Nano for centralized control allows efficient processing of sensor data, while the SMPS provides stable power for uninterrupted operation. The buzzer alarm and LCD display offer immediate auditory and visual alerts, ensuring quick awareness of dangers. This system demonstrates a cost-effective and reliable approach to improving safety in residential and industrial settings.

CHAPTER 6
Conclusion

6.1 Conclusion

The Home and Industrial Safety System represents a significant step forward in enhancing safety measures for residential and industrial environments. By integrating multiple sensors—such as gas, flame, smoke, and temperature sensors—the system provides comprehensive real-time monitoring of critical environmental parameters. The Arduino Nano serves as the intelligent core of the system, efficiently processing data from sensors and triggering safety responses when hazards are detected. This proactive approach minimizes the risk of fire outbreaks, gas leaks, and overheating, ensuring a safer living and working environment.One of the major strengths of the system is its real-time alert mechanism. The buzzer alarm delivers immediate audible warnings during hazardous conditions, while the LCD display provides clear, real-time updates on environmental status. This dual-layer alert mechanism ensures that users are swiftly informed, allowing for prompt action to prevent further escalation of danger. Additionally, the SMPS guarantees stable power supply to all components, enhancing the reliability and uninterrupted operation of the system.The project is also cost-effective, utilizing easily available components while maintaining high reliability and performance. Its modular design allows for easy upgrades and integration with IoT for remote monitoring, further extending its application. Overall, this project significantly contributes to enhanced safety measures, minimizing risks and safeguarding both property and human life.

6.2 Future Scope of Work

As we have already discussed about the limitations of our project so definitely there's room for improvement and thus, we have lots of future scope of work available to us for this project. Some of these are listed below:

- In future development this project can be develop by more sensor and alarm System
- In future develop a Integration with IoT (Internet of Things).
- In future, I will try it to apply in real field.
- In Future develop add extra power system.
- In the future, add a GSM module to send an SMS alert system.

REFERENCES

[1] Shih-Pang Tseng, Bo-Rong Li, Jun-Long Pan, and Chia Ju Lin,"An Application of Internet of Things with Motion Sensing on Smart House", 978-1-4799-62846/14

[2] D. bhattacharjee,P. Bhatnagar, S. choudhury, "Design and Development of a Flexible Reliable Smart Gas Detection System", IJCA, 31(2011) 1-8.

[3] I. Lita, I.B. Cioc and D. A. Visan, "A New Approach of Automatic Localization System Using GPS and GSM/GPRS Transmission", 29th International Spring Seminar on (ISSE-2006), 10-14 May, 115-119.

[4] Y.P. Tsang, K.L. Choy, T.C. Poon, G.T.S. Ho, C.H. Wu, H.Y. Lam, "An IoT-based Occupational Safety Management System in Cold Storage Facilities",International Workshop of advanced manufacturing and automation(IWAMA),2016

[5]. Karthik Srinivas, Vinay M. Prabhu, Srikrishna and Suraj M, "Industrial Safety Automation using IoT" Proc. Int. Conf. on Signal, Image Processing Communication & Automation, ICSIPCA

[6] Ismail, T., Das, D., Saikia, J., Deka, J., & Sarma, R. (2014). GSM based gas leakage warning system. International Journal of Advanced Research in Computer and Communication Engineering (April. 2014).

[7] Macker, A., Shukla, A. K., Dey, S., & Agarwal, J. (2018, May). ARDUINO Based LPG Gas Monitoring & Automatic Cylinder Booking with Alert System. In 2018 2nd International Conference on Trends in Electronics and Informatics (ICOEI) (pp. 1209-1212). IEEE.

[8] Varma, A., Prabhakar, S., & Jayavel, K. (2017, February). Gas Leakage Detection and Smart Alerting and prediction using IoT. In 2017 2nd

International Conference on Computing and Communications Technologies (ICCCT) (pp. 327-333). IEEE.

[9] Pavithraa.M, Priya.K, Priya.M, & Jenifer. Z. (2014). IoT BASED LPG GAS BOOKING AND MONITORING SYSTEM. International Research Journal of Engineering and Technology (IRJET)(March 2019).

[10] Mahalingam, A., Naayagi, R. T., & Mastorakis, N. E. (2012). Design and implementation of an economic gas leakage detector. Recent Researches in Applications of Electrical and Computer Engineering, 20-24.

[11] Fraiwan, L., Lweesy, K., Bani-Salma, A., & Mani, N. (2011, February). A wireless home safety gas leakage detection system. In 2011 1st Middle East Conference on Biomedical Engineering (pp. 11-14). IEEE.

[12] Faisal, M. M. A., & Rahman, S. M. (2017). Arduino based gas leakage detector with short message service and sound alarm. Journal of Emerging Trends in Engineering and Applied Sciences, 8(3), 113-116.

[13] Vijayalakshmi, S. R., & Muruganand, S. (2016). Real time monitoring of wireless fire detection node. Procedia Technology, 24, 1113-1119.

[14] Nagaosa, R. S. (2014). A new numerical formulation of gas leakage and spread into a residential space in terms of hazard analysis. Journal of hazardous materials, 271, 266-274.

[15] Chen, T. H., Yin, Y. H., Huang, S. F., & Ye, Y. T. (2006, December). The smoke detection for early fire-alarming system base on video processing. In 2006 International Conference on Intelligent Information Hiding and Multimedia (pp. 427-430). IEEE.

[16] Nahid, A. A., Hasan, M. T., & Bairagi, A. K. (2019, December). Simpler Design for Liquid Supply Line Leakage Monitoring. In 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI) (pp. 1-5). IEEE.

APPENDIX

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <DHT.h>

// Pin definitions
const int flamePin = 7;      // Flame sensor pin
const int gasPin = 8;        // Gas sensor digital pin
const int dhtPin = 4;        // DHT11 sensor pin

// DHT sensor setup
#define DHT_TYPE DHT11
DHT dht(dhtPin, DHT_TYPE);

// LCD setup
LiquidCrystal_I2C lcd(0x27, 16, 2);  // Adjust the I2C address if needed

void setup() {
  pinMode(flamePin, INPUT);
  pinMode(gasPin, INPUT);  // Gas sensor digital pin

  lcd.init();
  lcd.backlight();

  dht.begin();

  lcd.setCursor(0, 0);
  lcd.print("System Initializing...");
  delay(2000);
  lcd.clear();

  // Initialize serial monitor
  Serial.begin(9600);
}

void loop() {
  // Read sensor values
  int flameStatus = digitalRead(flamePin);
  int gasStatus = digitalRead(gasPin);  // Read digital output from gas sensor
  float temperature = dht.readTemperature();

  // Display temperature on LCD
  lcd.setCursor(0, 0);
  lcd.print("Temp: ");
  lcd.print(temperature);
  lcd.print(" C");
```

```
  // Check flame sensor
  if (flameStatus == LOW) {
    lcd.setCursor(0, 1);
    lcd.print("Fire Detected!  ");
    Serial.println("Flame Detected!");
  }
  // Check gas sensor
  else if (gasStatus == LOW) {  // If gas is detected
    lcd.setCursor(0, 1);
    lcd.print("Gas Detected!   ");
    Serial.println("Gas Detected!");
  } else {
    lcd.setCursor(0, 1);
    lcd.print("No Gas & Fire ");
    Serial.println("No Flame or Gas");
  }

  // Print temperature to serial monitor
  Serial.print("Temperature: ");
  Serial.print(temperature);
  Serial.println("°C");

  // Print gas sensor status to serial monitor
  Serial.print("Gas Sensor Status: ");
  Serial.println(gasStatus == HIGH ? "Detected" : "Not Detected");

  // Print flame sensor status to serial monitor
  Serial.print("Flame Sensor Status: ");
  Serial.println(flameStatus == HIGH ? "Detected" : "Not Detected");

  delay(1000);
}
```