e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
( Peer-Reviewed, Open Access, Fully Refereed International Journal )
Volume:06/Issue:04/April-2024 Impact Factor- 7.868 www.irjmets.com

# REAL TIME SOUND EVENT DETECTION FOR HUMAN AND INDUSTRIAL SAFETY SYSTEM USING IOT

**Dr. R. Arun*1, R. Ananthi*2, S. Annlin Merciya*3, R. Kanaga Durga*4**

*1Associate Professor, Computer Science Engineering P.S.R Engineer College Sivakasi, Tamil Nadu, India.

*2,3,4Computer Science Engineering P.S.R Engineer College Sivakasi, Tamil Nadu, India.

DOI : https://www.doi.org/10.56726/IRJMETS52891

## ABSTRACT

Given that the average lifespan has been steadily rising over the past several years, governments and private organizations have stepped up their efforts to provide for the older segment of the population. These groups built hospitals and retirement complexes, which are today overcrowded and have astronomical operating and maintenance expenditures. New methods of monitoring individuals with special needs at home are being envisioned by the latest advancements in communications and technology, which should enhance their quality of life at a reasonable cost. The purpose of this project is to show an Ambient Assisted Living (AAL) platform that can identify, evaluate, and detect certain auditory events that occur in everyday work environments. This will enable staff members to remotely monitor each worker's safety status in real-time. Noisy surroundings are inappropriate for teaching and learning activities, and they can negatively impact people's cognition and behavior in educational settings. Internet of Things (IoT) technology is one of the best means of keeping an eye on ambient noise levels and sound intensity for human safety. This work aims to demonstrate the development of an Internet of Things (IoT) noise monitoring system that consists of LCDs, LEDs, a sound sensor, and the NodeMCU IoT platform. The technology will sound a real-time warning if the noise level rises beyond the Environmental Department of Health's threshold noise limit. The findings obtained motivate professionals to continue researching in this area and allow medical professionals to use non-invasive remote monitoring techniques to monitor patients' status in real time.

## I. INTRODUCTION

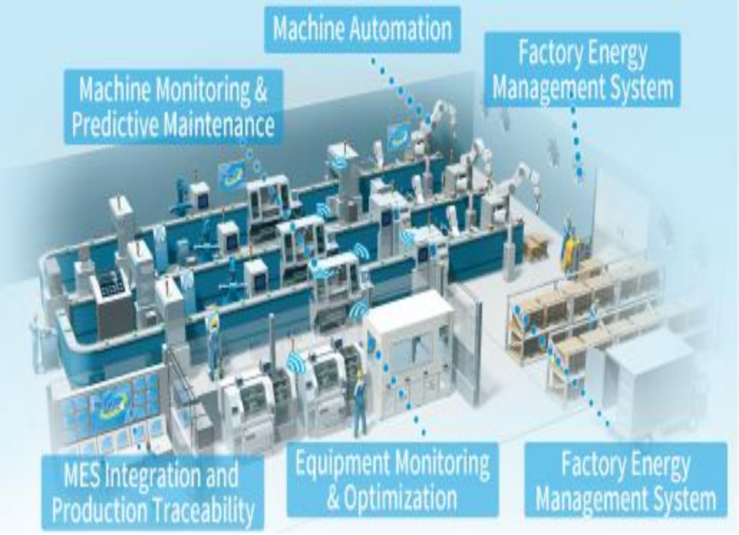
The mechanical sense of hearing uses changes in the surrounding medium's pressure to translate physical movements, or sounds, into nerve impulses. Industrial noise pollution is the term used to describe excessive and disruptive noise caused by industrial activities, which has a negative impact on the environment, human health, and general quality of life. In this context, the word "pollution" is important since it emphasizes how noise affects our environment negatively, especially the natural environment and human health. By adding the word "pollution," we highlight the fact that industrial noise is a type of environmental contamination that throws off the natural acoustic equilibrium rather than being just any old innocuous sound. The word "pollution" draws attention to the idea that this noise is an unwanted consequence of industrialization, much like other types of pollution like water or air pollution.

### 1.1 INDUSTRIAL NOISE

The term "industrial noise," sometimes used interchangeably with "industrial noise pollution," describes undesired or excessive sound generated by industrial operations and activities. This kind of noise pollution comes from a variety of industrial sources, including factories, manufacturing plants, building sites, energy producing facilities, and transportation hubs (such ports and airports). The following are the primary attributes of industrial noise:

Sound Intensity: Because of the presence of engines, heavy machinery, and other equipment, industrial areas may generate enormous volumes of noise. If the noise is not well regulated, it can get loud enough to harm hearing. Depending on the origins, industrial noise can have a wide variety of frequencies, although it frequently combines elements of both low- and high-frequency sounds.

Duration: Depending on the precise operations and activities taking place, industrial noise may be continuous or sporadic.


Machine Automation
Factory Energy Management System
Machine Monitoring & Predictive Maintenance
MES Integration and Production Traceability
Equipment Monitoring & Optimization
Factory Energy Management System

### 1.2 ENVIRONMENT MONITORING IN INDUSTRIES WITH ALERT

Globally, smart buildings are becoming more and more popular, and for good reason. In addition to saving money on energy, power, heating, and other expenses, smart buildings also lessen their environmental effect. By automatically regulating the temperature and lighting for optimal comfort, automation in smart buildings also contributes to an improvement in productivity. Smart building projects make up a large portion of new commercial construction projects, and over the next several years, the industry is predicted to increase at a rate of 34% each year. Many of the features and operations needed in a smart building, such as automation and temperature monitoring, may be facilitated by Room Alert in a number of ways. Almost any existing structure may become a smart building by utilizing local software and the Internet of Things (IoT).

Monitoring of Temperature in Industrial Environment

The capacity of smart buildings to modify temperature in response to external factors is one of their main features. To do this, a careful monitoring of the building's temperature is necessary to maintain it within the designated "comfort zone." The fact that most buildings only monitor temperatures in the areas where thermostats are installed is a drawback. By making it simple to install sensors across a facility, Room Alert offers far better insight into temperatures throughout the structure. This can assist in locating HVAC inefficiencies in a facility and potential energy waste related to overheating or cooling a specific region. Humidity is another component of environmental monitoring that is strongly tied to temperature. An office that is too hot or chilly might be equally uncomfortable as those that are overly humid. In addition, it can lead to early corrosion, mold and mildew problems, and equipment damage. A variety of interior and outdoor temperature and humidity sensors are available from Room Alert, enabling buildings to continuously and precisely monitor the environmental conditions. The facilities management of the building can be promptly notified if the temperature drops or rises too much.

### 1.3 AUTOMATION WHEN ENVIRONMENT ALERTS ARE DETECTED

The capacity of smart buildings to automatically adapt and take remedial action when certain thresholds are achieved is one of their main selling points. When used in conjunction with Device Manager, Room Alert allows users to design unique actions to assist address a variety of recognized environmental problems. When a flood sensor detects water, it can activate a pump. When smoke is detected, it can immediately cut off HVAC equipment and activate an exhaust fan to reduce air circulation throughout the facility. Smart building features include the ability to make corrections and the provision of a continuously monitored environment. In addition to helping to maintain safe and comfortable working conditions, Room Alert may have a significant impact on the general layout and functionality of a smart building. The sensor module's adaptable architecture enables cheap cost, compact size, and low power consumption, enabling installation into a range of industrial applications. Nevertheless, each sensor has its own readout circuit, which might result in an additional increase in size, cost, and power consumption. Therefore, two reconfigurable integrated circuits were built to monitor various environmental and healthcare signals in order to ensure the flexibility of the readout interfaces in an effective manner. In particular, a healthcare readout circuit was created with every basic element configurable to support diverse body signals with varying amplitude and frequency ranges, and an environmental readout circuit was designed with a dual-mode operation to decrease power consumption.

### 1.4 ENVIRONMENTAL PARAMETERS

Heating and ventilation: It is possible to continually monitor the building's total energy use. Studies show that more than 60% of the energy used in commercial buildings is used for lighting, HVAC, and heating. By implementing the idea of environmental monitoring in smart buildings with IoT-based automated controls, the utilization may be reduced by more than 40%. Our team has developed relevant IOT sensors that can also be used to detect air velocity.

Weather: Sensors can track and analyze variables like temperature, wind speed, relative humidity, and ground temperature to improve the surrounding environment of buildings.

Light: Sensor modules can be used to control artificial and natural lighting. Both the brightness and the levels are automatically adjustable. Sensor modules make it simple to monitor a variety of environmental parameters, including air quality, heat flow, and groundwater depth. The UV sensor would identify the hazardous rays and allow for their avoidance. It is also possible to monitor gas and electricity usage and promptly set relevant notifications.

## II. LITERATURE SURVEY

### 2.1 l. A. H. Celdran, f. J. G. Clemente, p. Gómez, l. F. Maimo, c. C. Sarmiento, c. J. Del canto masa, and r. In ieee access, volume, m. Nistal, "on the generation of anomaly detection datasets in industrial control systems," 7, 2019, pp. 177460–177473,

The physical world and public safety have been greatly impacted by many hacks that have impacted Industrial Control Systems (ICS) in recent decades. These days, machine learning and, more recently, deep learning are the foundations of the methods performing the best in the identification of cyber abnormalities. Owing to the early stage of cybersecurity research in ICS, there aren't enough datasets available to evaluate anomaly detection methods. In this study, we offer a four-step technique (attacks selection, assaults deployment, traffic collection, and features computation) to build trustworthy anomaly detection datasets in ICS. The Electra Dataset was created using the suggested approach, and its primary objective is to assess cybersecurity measures in an electric traction substation utilized by the railroad sector. We train many Machine Learning and Deep Learning models to identify abnormalities in ICS using the Electra dataset. Our results indicate that the models perform well, indicating that our dataset is suitable for usage in real-world systems.

### 2.2 times. Li, Y.-C. Tian, C. Zhou, and Y. "A Dynamic Decision-Making Strategy for Intrusion Response in Industrial Control Systems," by Qin, IEEE Trans., 1987. IND. Inform., vol. 15, no. 5, May 2019, pp. 2544–2554.

Critical infrastructure is at ever-greater risk as industrial control systems (ICSs) deal with a growing number of cybersecurity-related problems. It is crucial to have a suitable security plan in order to reduce hazards. However, current efforts to make decisions in ICSs are limited in some ways. For example, strategies for safeguarding both the physical and cyber domains are not taken into account, and security and system needs are traded off. This work presents a decision-making technique for intrusion response in intrusion detection systems (ICSs) to solve these constraints. It attempts to guard the most "dangerous" attack vectors, react to functional failures, and quickly ascertain the best security approach against assaults. This strategy involves a thorough investigation of the spread of attacks to build measures that span both the cyber and physical worlds. They guarantee that the universe of potential security strategies is comprehensive. Through multi-objective optimization, many Pareto optimum solutions are identified from the strategy space. Maximizing the objective vector, which is made up of the security, system, and state benefits, is the goal. Next, a distance-based assessment approach is applied to rank these solutions in order of priority. This method finds the best protective capability by bringing the chosen strategy's goal vector as near to the ideal one as possible. A case study on a simulated process control system illustrates the efficacy of the suggested methodology.

**2.3 M. J. L. Kirtley, S. Madnick, G. Angle, and S. Khan, "Cyberattacks that could physically harm industrial control systems: identifying and anticipating threats," IEEE Power Energy Technol. System. Vol. J. 6, no. 4, December 2019, pp. 172-182**

In order to improve flexibility and simplify commissioning and maintenance, reconfigurable, network-enabled devices are increasingly in charge of physical control systems. Vulnerabilities result from such capabilities. Malicious actors have the ability to remotely reprogramme devices to behave in unexpected ways, endangering infrastructure, mechanical devices, and human life. This study analyzes the risks posed by software-controlled variable frequency drives (VFDs), presents examples of real harm done to cyber-physical systems in the past, and shows a demonstration of a small-scale assault on common VFD equipment.

**2.4 Q. Zhang, B., Xiong, N., Zhou, C., Tian, Y.-C., and Qin. Hu, "AN INTRIGUAL CYBERSECURITY RISK ASSESSMENT DYNAMIC THROUGH A FUZZY PROBABILITY BAYESIAN NETWORK APPROACH," IEEE Trans. IND. Inform., vol. 14, no. 6, June 2018, pp. 2497–2506,**

Cybersecurity is becoming a difficult issue in industrial control systems (ICSs) since data network technologies are being used in ICSs more and more. An essential component of protecting ICS cybersecurity is dynamic cybersecurity risk assessment. However, because there is no historical data, developing a risk propagation model for ICSs is challenging. This article presents a fuzzy probability Bayesian network (FPBN) method for evaluating dynamic risk. First, an FPBN is set up to analyze and forecast the spread of cybersecurity threats. In our technique, we substitute fuzzy probabilities for the crisp probabilities employed in normal Bayesian networks (BNs) to solve the challenge of inadequate historical data. Then, for the dynamic evaluation of ICS cybersecurity risk, an approximate dynamic inference method is created. To lessen the impact of noise evidence brought on by system flaws, it is integrated with a noise evidence filter. A basic chemical reactor control system is used for experiments to show how successful the suggested method is.

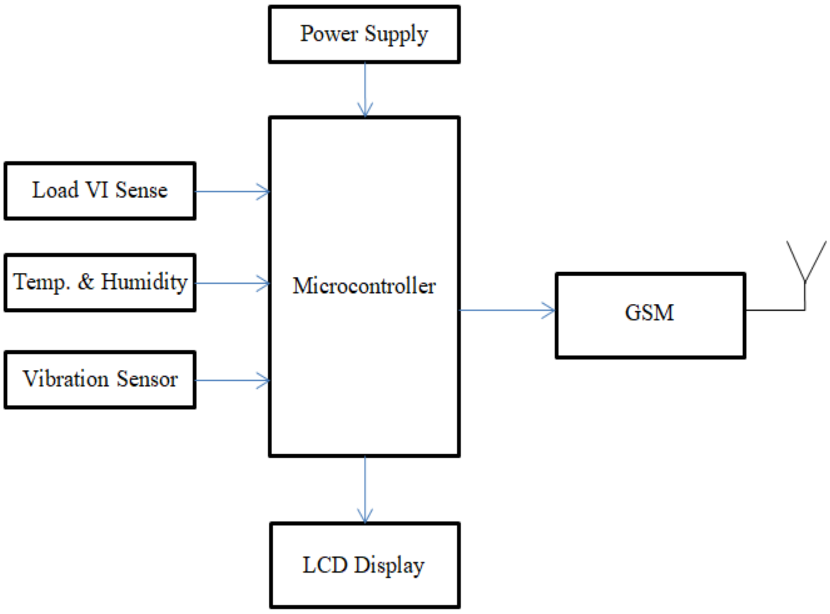
**2.5 times. Li, N. Xiong, C. Zhou, Y.-C. Tian, and Y. Qin, "RISK ANALYSIS IN INDUSTRIAL CONTROL SYSTEMS: ASSET-BASED DYNAMIC IMPACT ASSESSMENT OF CYBERATTACKS," IEEE Trans. IND. Inform., vol. 14, no. 2, February 2018, pp. 608–618,**

The advancement of information, communications, and technology has led to an increasing number of cybersecurity concerns for contemporary industrial control systems (ICSs). As a result, there are progressively more serious hazards to vital assets and infrastructure. As a result, risk analysis emerges as a crucial yet understudied subject for ICS hack risk prevention. This research presents a dynamic impact assessment technique for risk assessments in ICSs to address this issue. The method uses comprehensive asset knowledge recognition to dynamically forecast the trajectory of cybersecurity effect. An asset's construction, function, performance, location, and business attributes are all abstracted. Object-oriented asset models that incorporate the mechanism of common cyberattacks are developed at both the component and system levels based on the function and performance qualities of the asset. Models that describe how behaviors evolve for a particular asset or system are used to examine how cyberattacks spread. Next, the location and commercial attributes of the asset are used to quantify the overall impact from all potential impact outcomes. The method may also be used specifically to rank important system characteristics and prioritize important assets based on effect assessments. The efficacy of the methodology offered is exhibited by simulated analyses pertaining to a chemical control system.

## III. EXISTING SYSTEM

Systems for automation and safety monitoring have traditionally been created to satisfy the needs of a specific monitoring application. The industrial application has already beyond the simple connectivity of several major back-end systems, and an increasing number of subterranean physical devices enable software systems to effortlessly access the condition of objects and their surroundings. In actuality, the majority of works are built on fragile, hard-to-adapt monolithic system designs. Individuals employed in the industrial sector encounter a variety of environmental conditions. In order to solve that issue, we are employing intelligent helmets for coal miners that are ZigBee based. Industrial accidents were erratic and caused by a variety of variables; in addition to causing enormous financial losses, they also directly jeopardize the safety of miners.

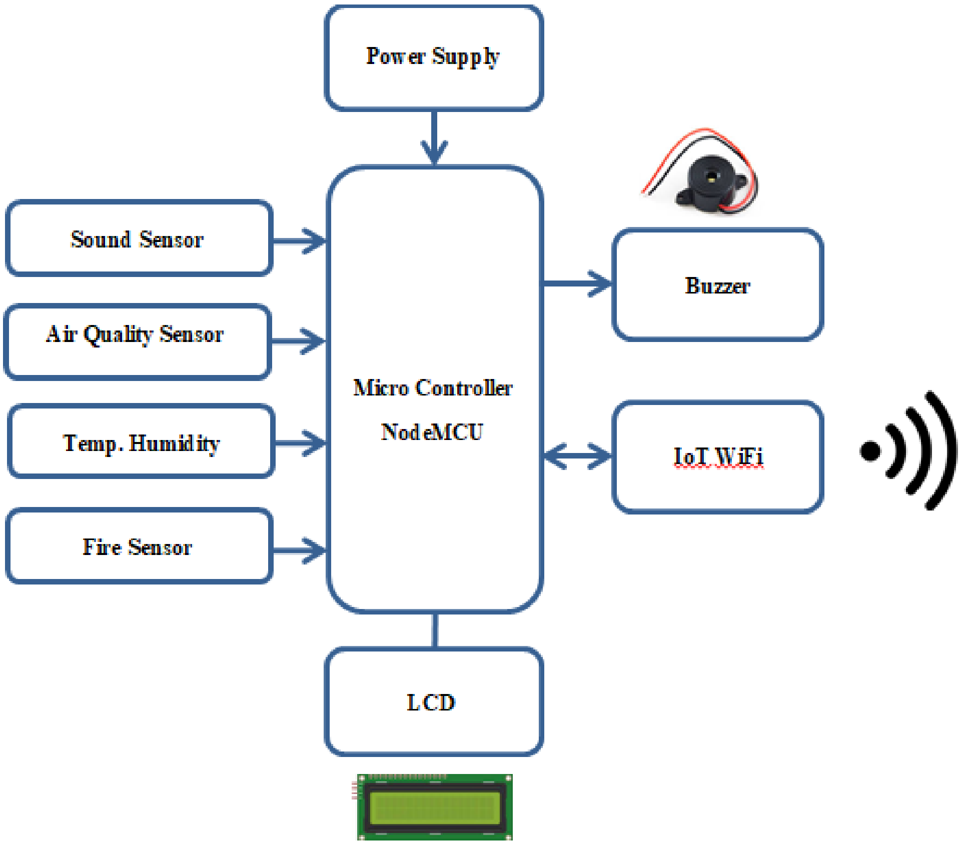
The method of cybersecurity risk propagation in ICSs differs from that in normal network systems since an ICS is a cyber-physical system. The majority of ICS assaults seek to damage ICS assets, such as people, the environment, and machinery. In the past, automation and safety monitoring systems were usually created to satisfy the needs of a single monitoring application. The application already does more than just link a couple sizable back-end systems together.



**Existing Block Diagram**

## IV. PROPOSED SYSTEM

Operational technology (OT) and information technologies (IT) comprise hardware and software systems that are essential for controlling and observing actual sensor field equipment. The intrinsic connection and visibility that IT and OT offer to supply chain information concerning transportation, assets, procedures, and completion timelines is crucial. This keeps the ICS competitive and efficient by supplying information to remote control and management units. This system's goal is to produce fine-grained maps of noise and pollution in order to identify metropolitan regions that have a serious detrimental impact on public health. While using their cellphones, users continuously get sensor readings from built-in and wearable devices. Periodically, the captured data is separately moved to cloud servers. Mobile Crowd Sensing (MCS) service is used by cloud servers to provide dense sensor readings and offer methods for finding novel occurrences in urban settings. A graphical user interface (GUI) application is provided by the Human Machine Interface (HMI) to facilitate communication between hardware, control systems, and human operators (staff). Trends, historical data, and current status are shown by HMI based on logs and data collected from the ICS environment. The dashboards that MI offers allow users to create, set control points, monitor, and define the operational parameters needed for regular sensor and controller use. The control element of the ICS advertisement that offers process management is called Micro Controller (MC). Actuators and sensors may be remotely accessed, controlled, and supervised by MC. In order to carry out activities and finish operations, Control Server & Loops host supervisory control systems and connect with each low level, on-field control device, such as actuators and AMM. Sensor signals, motors, gears, control valves, breakers, and other electromechanical devices are all interpreted by the control loop. Smart gadgets known as intelligent electric devices (IEDs) gather information, exchange it with other devices, and carry out local processing automatically. Reote Maintenance & Diagnostics helps to avoid issues with hardware and software within ICS by detecting and stopping abnormal operations or failures.



**Proposed block diagram**

### 4.1 PROPOSED BLOCK DESCRIPTION

- The lightweight mashup architecture is split into two parts from the structural point of view, namely, Air safety monitoring, noise, and Low-power device monitoring based on WSN
- The suggested method left the networks open to behavior-based device assaults related to industrial machine breakdowns.
- Process analytics to analyze the efficacy of threshold values in signature-based detection approaches and identify assaults and malfunctions in industrial control infrastructure systems.
- To identify hidden processes in logs from industrial control devices and identify real-time behavior-based assaults.
- The LM 393 sound sensor is utilized to read the ambient sound level data for the hardware components. To get accurate sound level measurements, the sound sensor's reading is calibrated using an actual sound level meter.
- When the measurement goes beyond the predetermined threshold, the 16x2 LCD will display the sound level readings for the studied area and issue a warning stating that the sound level is high. In the event that a user's vision is impaired, they may still determine the volume of sound by utilizing the red, blue, and green light emitting diodes (LEDs) that are positioned beneath the LCD.
- An LED serves as an indication to show when noise levels are extremely high. Red, blue, and green indicate low, middle, and high noise levels, respectively. These parts, which include the LCD, LEDs, and sound sensor, will all be linked to the ESP8266 NodeMCU.

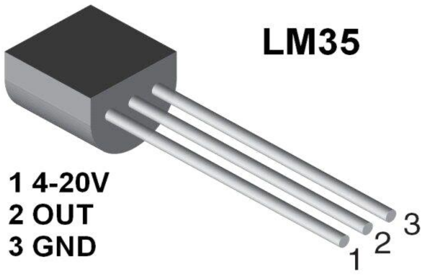
The output voltage stays constant within predetermined voltage variation limits, even when the output load varies within a range that is acceptable. The manufacturer's specification documents detail these restrictions. Voltage regulators come in two varieties: the 78xx series and the 79xx series.

### 4.2 HUMIDITY SENSOR

**Humidity sensor**

The amount of water in the air is called humidity. Both human comfort and several industrial production processes can be impacted by the amount of water vapor in the air. Water vapor also affects a number of other chemical, biological, and physical processes. Measuring humidity in industries is important since it may have an impact on employee health and safety as well as the product's commercial costs. Humidity detection is therefore crucial, particularly in industrial process control systems and human comfort systems. Humidity control or monitoring is critical for many home and commercial applications. Wafer processing in the semiconductor industry requires careful control and monitoring of humidity and moisture levels. Humidity control is necessary in medical applications for biological products, pharmaceutical processes, incubators, sterilizers, and breathing equipment. In addition, humidity management is required in the manufacture of paper and textiles, food processing, dryers, ovens, and chemical gas purification. Humidity measurement is crucial in agriculture for monitoring soil moisture, protecting plantations from dew, and other reasons. Humidity sensors are used in all of these household applications—including cooking control for microwave ovens, living environment control in buildings, and many more—to give an indicator of the moisture content of the surrounding air.

### 4.3 TEMPERATURE SENSOR



**Temperature sensor**

The output voltage of the precision integrated-circuit temperature sensors of the LM35 series is directly proportional to the temperature in Celsius (Centigrade). Because the user does not need to deduct a significant amount of constant voltage from the output of the LM35 in order to get suitable Centigrade scaling, it offers an advantage over linear temperature sensors calibrated in˚ Kelvin. For the LM35 to give typical accuracies at room temperature and across the whole temperature range of -55 to +150˚C, no extra calibration or trimming is needed. Trimming and wafer-level calibration provide low costs. The LM35's ability to interface with readout or control circuitry is facilitated by its low output impedance, linear output, and perfect intrinsic calibration. It may be utilized with plus and minus supplies or a single power supply. Its self-heating is very low, less than 0.1 ˊC in still air, because it uses just 60 µA from its supply. The operating temperature range for the LM35 is −55˚ to +150˚C, whilst the LM35C is rated for −40˚ to +110˚C (−10˚ with enhanced accuracy). The LM35C, LM35CA, and LM35D are also offered in the plastic TO-92 transistor packaging, whereas the LM35 series is packed in hermetic TO-46 transistor packages.

### 4.4 CO2 SENSOR

The gas sensor responds well to natural gas and is very sensitive to propane, butane, and LPG. The sensor is particularly useful for detecting all natural gases, but it may also be used to detect other flammable gases. This smoke sensor uses little electricity and is inexpensive.

**Co2 sensor**

SnO2, a substance having reduced conductivity in clean air, is the sensitive component of the MQ-6 gas sensor. The conductivity of the sensor increases along with the concentration of the target flammable gas when it is present. Please use a basic electro circuit to convert the change in conductivity to the appropriate gas concentration output signal. The MQ-6 gas sensor responds well to natural gas and is very sensitive to propane, butane, and LPG. The sensor is inexpensive and adaptable to a variety of uses. It may be used to detect many flammable gases, including methane.

### 4.5 LCD (LIQUID CRYSTAL DISPLAY)

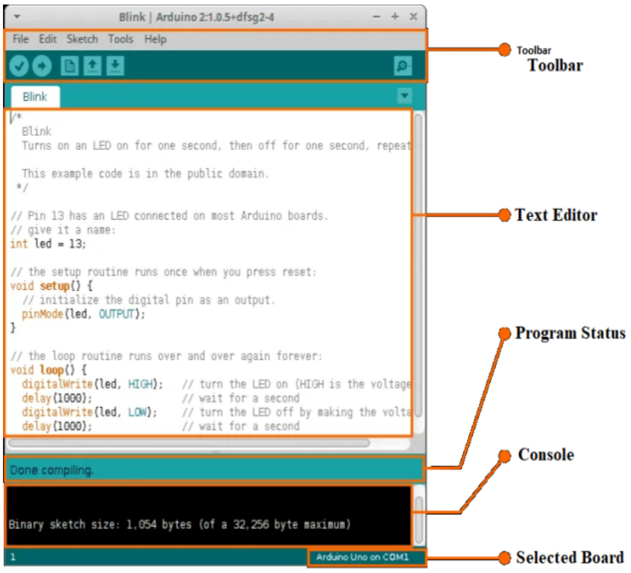
**LCD Display**

An electrical display module with many uses is the LCD (Liquid Crystal Display) screen. A 16x2 LCD display is a relatively simple module that is frequently seen in many different kinds of circuits and devices. An LCD that is 16 by 2 may show up to 16 characters on each of its two lines. Every character on this LCD is shown as a 5x7 pixel matrix. There are two registers on this LCD: Command and Data. The data to be displayed on the LCD is stored in the data register. The data is the ASCII value of the character to be displayed on the LCD. Numeric and alphanumeric characters are displayed on liquid crystal displays in dot matrix and segmental displays. The command register contains the command instructions given to the LCD. The two liquid crystal materials, nematic and cholesteric, whose schematic molecular organization is seen in fig., are often employed in display technology. Nematic Liquid Crystals (NLCs) are the most widely used type of liquid crystal structure. All of the molecules in this maintain total translational flexibility while roughly aligning themselves parallel to a single axis (director). Normally transparent, the liquid polarizes and becomes opaque when exposed to a high electric field, which disrupts the well-ordered crystal structure. The materials turn transparent when the applied electric field is removed, allowing the crystal structure to return to its natural shape. There are two sorts of LCDs based on their structure. They are

### 4.6 ARDUINO SOFTWARE (IDE)

Based on the ATmega328P, the Arduino Nano is a compact, feature-rich, and breadboard-friendly board. With a smaller size factor, it provides the same specifications and connections as the UNO board.

The Arduino Software (IDE), an online and offline Integrated Development Environment that is compatible with all of our boards, is used to program the Arduino Nano. See the Getting Started page for further details on how to begin using the Arduino software.



```
/*
  Blink
  Turns on an LED on for one second, then off for one second, repeat

  This example code is in the public domain.
 */

// Pin 13 has an LED connected on most Arduino boards.
// give it a name:
int led = 13;

// the setup routine runs once when you press reset:
void setup() {
  // initialize the digital pin as an output.
  pinMode(led, OUTPUT);
}

// the loop routine runs over and over again forever:
void loop() {
  digitalWrite(led, HIGH);   // turn the LED on (HIGH is the voltage
  delay(1000);               // wait for a second
  digitalWrite(led, LOW);    // turn the LED off by making the volta
  delay(1000);               // wait for a second
```

```
Done compiling.
```

```
Binary sketch size: 1,054 bytes (of a 32,256 byte maximum)
```

```
1                                   Arduino Uno on COM1
```

**Arduino IDE**

Using the Arduino Desktop IDE, the Arduino Nano

Installing the Arduino Desktop IDE is required if you wish to program your Arduino Nano offline. A Mini-B USB connection is required to connect your Arduino Nano to your computer. The blue LED, which is located on the top of the Arduino Nano 3.0 and the bottom of the Arduino Nano 2.x, indicates that the board is also powered by this.

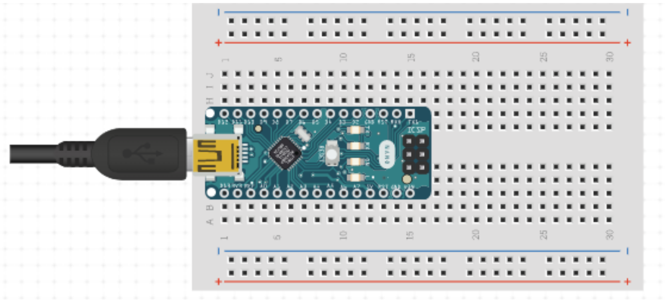
NANO Connecting Different USB Port Types

Launch your initial drawing.

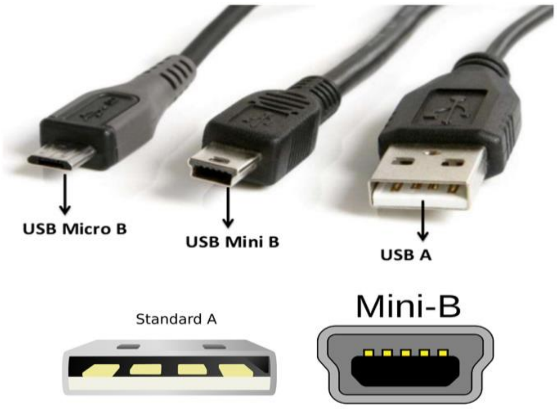
• Click File > Examples > 01.Basics > Blink to open the sample sketch of an LED blinking.

Choose the port and board type that you want.

• Choose Board > Arduino AVR Boards > Arduino Nano under Tools.



**Arduino NANO Interface**



**NANO Interfacing USB Types of Port**

## V. RESULTS AND DISCUSSION

The sound sensor will log the sound pressure levels in the region under investigation. Subsequently, the information is transmitted to the Thingspeak cloud server. MATALB Incorporation created Thingspeak, a development platform specifically designed for online applications and mobile devices. Thingspeak was selected as the system's cloud server due to its ease of hardware connectivity. The information is kept in the Thingspeak real-time data log, which the user may view online as well. The program then receives data from Firebase. Users may use the app to determine the sound level reading, the best time to study, and the elements that lead to high noise levels depending on the sound level measurement.

## VI. CONCLUSION

Dedicated, air-gapped, centralized infrastructures have given way to distributed, corporate systems that can be accessed via the Internet as Industrial Control Systems have evolved. Even though efficiency, speed, and accuracy quality have all grown, ICS is now more vulnerable to insecure websites. This research built an IoT-based air and sound pollution monitoring system. In addition, this technology lets users track and compare data on sound and air pollution across two situations. While noise pollution was often regarded to be only an irritation, research indicates that prolonged exposure to noise can cause hearing loss, sleep disturbances, high blood pressure, and injuries. For this reason, it is crucial to monitor the amount of noise pollution. Additionally, it may have an impact on how people learn in terms of comprehension and behavior. As a result, this study looks into and then suggests the best time for students to study using an Android application and cloud server to create an Internet of Things-based noise monitoring system. The prototype also allows for the identification of the dominating sound that raises the noise level in the study area.

## VII. REFERENCES

[1] L. A. H. Celdran, F. J. G. Clemente, P. Gómez, L. F. Maimo, C. C. Sarmiento, C. J. Del Canto Masa, and R. Regarding the creation of datasets for anomaly detection in industrial control systems, M. Nistal, IEEE Access, vol. 7, 2019, pp. 177460–177473,

[2] X. Li, Y.-C. Tian, C. Zhou, and Y. Qin, "A dynamic decision-making approach for industrial control systems intrusion response," IEEE Trans. IND. Inform., vol. 15, no. 5, May 2019, pp. 2544–2554.

[3] M. J. L. Kirtley, S. Madnick, G. Angle, and S. Khan, IEEE Power Energy Technol., "Identifying and anticipating cyberattacks that could cause physical damage to industrial control systems." System. Vol. J. 6, no. 4, December 2019, pp. 172-182

[4] Q. Zhang, B., Xiong, N., Zhou, C., Tian, Y.-C., and Qin. A fuzzy probability Bayesian network technique for dynamic cybersecurity risk assessment in industrial control systems was described by Hu in the IEEE Trans. IND. Inform., vol. 14, no. 6, June 2018, pp. 2497–2506,

[5] X. Li, N. Xiong, C. Zhou, Y.-C. Tian, and Y. Qin, "Dynamic impact evaluation of cyberattacks using assets for risk assessment in industrial control systems," IEEE Trans. IND. Inform., vol. 14, no. 2, February 2018, pp. 608–618,