

# IOT BASED AIR POLLUTION MONITORING SYSTEM TO CREATE A SMART ENVIRONMENT

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**Abstract** - Air quality has been contrarily influenced by modern exercises, which have caused uneven characters in nature. The issue of air contamination has turned into a major worry for some individuals, particularly those living in modern zones. Air contamination levels can be estimated utilizing brilliant sensors. Moreover Internet of Things (IoT) innovation can be coordinated to remotely identify contamination with no human association. The information accumulated by such a framework can be transmitted in a split second to an electronic application to encourage checking ongoing information and permit impending danger the board. In this paper a whole web of things framework that screens Air contamination by gathering ongoing information in explicit areas. This information is broke down and estimated against a foreordained limit. The gathered information is sent to the concerned authority association to tell them in the event of any infringement with the goal that they can take the fundamental measures. Moreover if the estimation of the deliberate poisons surpasses the edge, a caution framework is activated taking a few activities to caution the encompassing individuals.

**Key Words:** Air pollution monitoring system; Android; sensors; GPS; Cloud; Distributed systems; Air-pollution safe route; Air quality index.

## 1. INTRODUCTION

Remote sensor systems (WSNs) are dynamically influencing regular living. A WSN is a system comprising of sensor hubs. Every sensor can distinguish certain variables like pneumatic force, air organization, and water quality. WSNs are utilized in a wide assortment of settings, including individual space, mechanical floors, horticulture, home utility checking frameworks, plant mechanization, car, and numerous different fields. WSNs are identified with the idea of IoT. In IoT, gadgets are interconnected to transmit information by means of conveyed sensor systems. IOT has valuable applications in the therapeutic field. Gadgets, for example, cell phones and detecting frameworks can be related to make a foundation that gives access to social insurance data and administrations. This approach is referred to as "Mobile-Health" [1]. Air is the most indispensable constituent of condition for the sustenance of life on earth. In unadulterated air, the extent of various constituents like oxygen, nitrogen and different gases is fixed

and distinct. It might be noticed that air can't be unadulterated in light of the fact that a few gases like sulfur dioxide, carbon monoxide, oxides of nitrogen, outflow from volcanoes and bogs, salt shower, dusts from plants and so forth., are persistently added to the air by a characteristic procedures. Thus, air is polluted when its natural composition is disturbed either by natural or man-made sources.

The issue of air contamination has turned into a major worry for some individuals, particularly those living modern regions. A huge number of individuals overall bite the dust as a result of air contamination. Huge numbers of these passings happen in enormous urban areas, air exhaust from vehicles, control plants fills the air with perilous particles. Therefore, the dimension of unsafe gases is risky to people, creatures, and plants. Indoor air contamination and urban air quality are viewed as two of the world's most noticeably awful dangerous contamination issues.

### 1.1 Classification of Air Pollutants

Air pollutants are of two types

- Primary air pollutants
- Secondary air pollutants

#### 1.1.1 Primary Air Pollutants

These are the unsafe synthetic which straightforwardly goes into air because of characteristic occasions or human exercises. For instance, when carbon containing substance is singed, it will discharge CO<sub>2</sub> and/or CO to climate. These gases straightforwardly going into environment impact the biosphere or named as essential toxins. It is seen that there are for the most part five essential poisons which contribute together over 90% of worldwide air contamination. These are in particular carbon monoxide (CO), Nitrogen oxides (NO<sub>2</sub>), Oxides of sulfur (SO<sub>2</sub>), Hydrocarbons (HC) and particulates. Transportation represents more than 46 % of the complete poisons created every year and henceforth stay as the guideline wellspring of air contamination. Carbon monoxide is the significant individual air contamination with a tonnage coordinating that of all other toxin together.

### 1.1.2 Secondary Air Pollutants

These are the harmful chemicals produced in air due to chemical reaction in between two or more components that is the reaction in-between primary air pollutant and some components of air. Usually, the primary air pollutants suffer chemical changes in presence of H<sub>2</sub>O, O<sub>2</sub> and ultraviolet radiation of sun to form secondary pollutants.

## 2. PROBLEM DEFINITION

Air pollution in large urban areas has a drastic effect on humans and the environment. Ecological issues in India are growing quickly. Air contamination is mainly caused by vehicles and industries which cause various respiratory diseases such as asthma and sinusitis. The quality of air is inferior in metropolitan cities like Kolkata, Delhi, and Mumbai due to a large amount of carbon dioxide and other harmful gases emitted from vehicles and industries.

An extensive number of projects have been described in the literature that utilize low-cost air pollution sensing devices that can be carried by individuals or by versatile vehicles [9]. In two studies, [10] [11], the authors demonstrated an environmental sensing approach that reinvigorate attention and sympathy of citizens toward pollution. Exposure Sense [12] is a portable participatory sensing framework that is used to screen one's everyday activities.

In another study [13], the authors present a cloud-based system that uses knowledge-based discovery to find real-time air quality data. The data are collected by monitoring stations that are placed in various geo-locations. This system uses mobile clients for monitoring purposes.

Re et al. [14] presented an Android application which provides users with information about air quality. By joining user area information and metropolitan air quality data provided by monitoring stations, this application provides a ubiquitous and unobtrusive monitoring [15] framework that is ready to advise users about their daily air pollution exposure.

Reshi et al. [16] designed a WSN platform, called VehNode, that provided automobiles with the capacity to monitor the level of pollutants in smoke released by the vehicle.

Mujawar e al. [17] outlined an air pollution contamination measuring system utilizing WSN for use in Solapur City. Micro-sensor nodes detect the target gas by measuring the sensing layer's electrical conductivity. When the gases touch the surface of the sensor they are assimilated and the conductivity changes. Also, a semiconductor sensor is used at the emission outlet of the vehicle to sense the level of pollutants and transmit this level to the microcontroller [7].

## 3. PROPOSED WORK

The main objectives of this proposed architecture is

- To aid in reducing human health problems due to industrial activities.
- To find solutions for the increasing problems of harmful gases amounting from industrial activities.

In the paper "IoT based air contamination observing framework utilizing arduino", we depict a total brilliant framework to control air contamination, subsequently making a keen situation. Air contamination levels can be levels can be estimated utilizing shrewd sensors. Moreover, Internet of Things innovation can be coordinated to remotely, identify contamination with no human collaboration. The information accumulated by such a framework can be transmitted in a split second to an online application to encourage checking ongoing information and permit impending danger the board. These information is examined and estimated a foreordained edge. The gathered information is send to the concerned authority association to advise them on the off chance that any infringement with the goal that they can take the important measures. Moreover if the estimation of the deliberate toxins surpasses the limit, an alert framework is activated taking a few activities to caution the encompassing individuals. Internet of Things (IoT) technology can be integrated to remotely detect pollution without any human interaction .An entire Internet of Things system that monitors air pollution by collecting real time data in specific locations. This data is analyzed and measured against a predetermined threshold. The collected data is send to concerned official organization to notify them in case of any violation so that they can take the necessary measures.

### 3.1 BLOCK DIAGRAM:

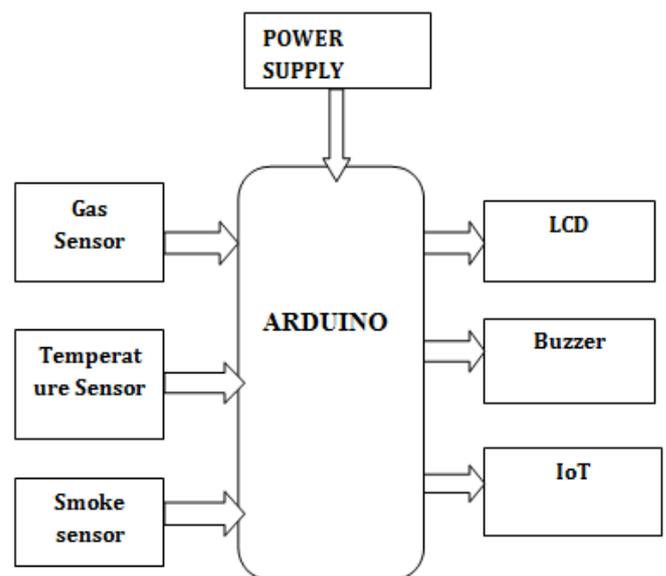


Fig -1: Proposed Block diagram

## 4. Hardware Required

### 4.1 Arduino UNO

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by arduino. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits. The board has 14 Digital pins, 6 Analog pins, and programmable with the Arduino IDE (Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under Common Creative Attribution Share-Alike 2.5 license and is available on the arduino website. Layout and production files for some versions of the hardware are also available. "UNO" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The UNO board and version 1.0 of arduino Software (IDE) were the reference versions of arduino, now evolved to newer releases. The UNO board is the first in a series of USB arduino boards, and the reference model for the arduino platform. The ATmega328P on the arduino UNO comes pre programmed with a boot loader that allows uploading new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The UNO also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it uses the Atmega16U(Atmega8U2 up to version R2) programmed as a USB-to-serial converter.



Fig -1: Arduino Board

### 4.2 DTH 11 Humidity Sensor

DHT11 Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By

using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

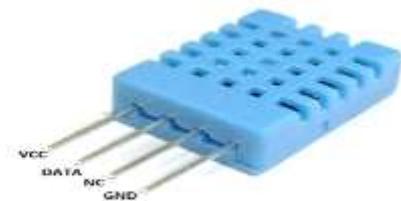


Fig -2: DTH 11 Humidity Sensor

### 4.3 MQ 7 Gas Sensor

Sensitive material of MQ-7 gas sensor is SnO<sub>2</sub>, which with lower conductivity in clean air. It make detection by method of cycle high and low temperature, and detect CO when low temperature (heated by 1.5V). The sensor's conductivity is more higher along with the gas concentration rising. When high temperature (heated by 5.0V), it detects Methane, Propane etc combustible gas and cleans the other gases adsorbed under low temperature. . MQ-7 gas sensor has high sensitivity to Carbon Monoxide, Methane and LPG. The sensor could be used to detect different gases contains CO and combustible gases, it is with low cost and suitable for different application



Fig -3: MQ 7 Gas Sensor

### 4.4 LCD

Liquid Crystal Display (LCD) is used to display the output to the user in the form of GUI (Graphic User Interface) and a mono chromatic display. LCD used in this project is JHD162A series. There are 16 pins in all. They are numbered from left to right 1 to 16 (if you are reading from the backside).

Generating custom characters on LCD is not very hard. It requires the knowledge about custom generated random access memory (CG-RAM) of LCD and the LCD chip controller. Most LCDs contain Hitachi HD4478 controller. CG-RAM is the main component in making custom characters. It stores the custom characters once declared in the code. CG-RAM size is 64 byte providing the option of creating eight characters at a time. Each character is eight byte in size.

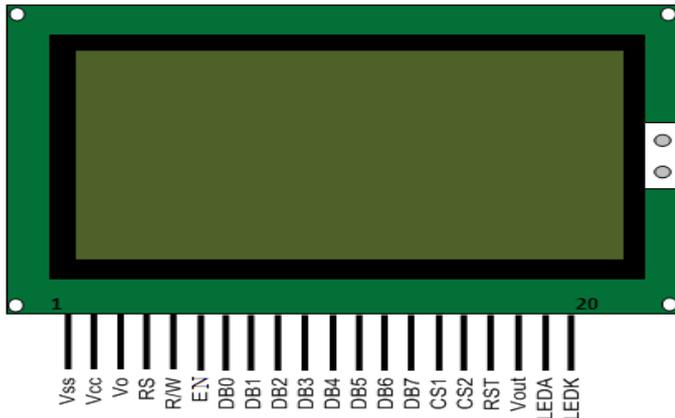


Fig -4: LCD

## 5. Software Required

### 5.1 Arduino IDE

The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, MacOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program avrdude to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

### 5.2 Thingspeak

ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social

network of things with status updates". ThingSpeak was originally launched by Io Bridge in 2010 as a service in support of IoT applications. ThingSpeak has integrated support from the numerical computing software MATLAB from Math Works, allowing ThingSpeak users to analyze and visualize uploaded data using Mat lab without requiring the purchase of a Mat lab license from Mathworks. ThingSpeak has a close relationship with Math works, Inc. In fact, all of the ThingSpeak documentation is incorporated into the Mathworks' Matlab documentation site and even enabling registered Mathworks user accounts as valid login credentials on the ThingSpeak website. The terms of service and privacy policy of ThingSpeak.com are between the agreeing user and Mathworks, Inc.

## 6. RESULTS

A complete smart system to control air pollution, hence creating a smart environment that utilizes comprehensive intelligent service aimed at monitoring air pollution. Our approach seeks to protect residents living near industrial areas by reporting such environmental violation to the government affiliated authorities.

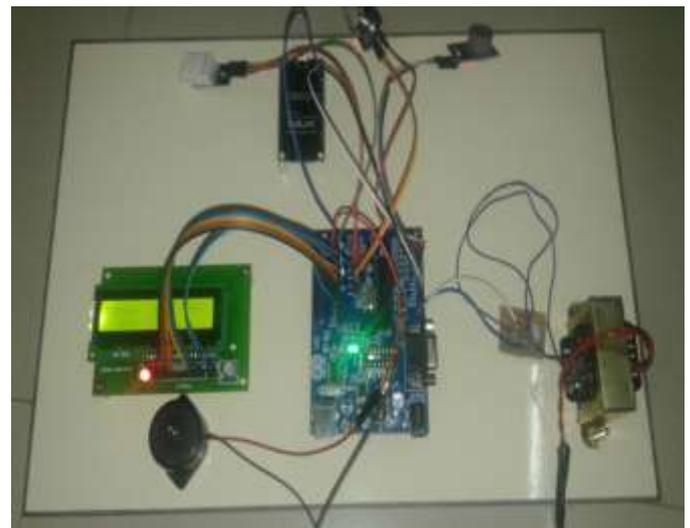


Fig -5: Hardware Implementation

Designed the Android application using the Google App-Inventor Integrated Development Environment (IDE) and Java programming language. The Android application communicates with the microcontroller through ThingSpeak cloud. Using the REST API request methods such as GET, POST, PUT, and DELETE, we can create a channel and update its feed, update an existing channel, clear a channel feed, and delete a channel. We sent a Java Script Object Notation (JSON) GET Request to ThingSpeak by using REST API Web Service and channel ID and field number within its parameters. We received the response from ThingSpeak in JSON format and populated the tables in the Android application by using JSON Parser. The end users run the Android application and it allows them to monitor the real-

time temperature and humidity readings for the monitored area e.g. a room. The user authentication interface is shown in Figure 4.5. Our application is efficient, flexible with a user friendly graphic user interface (GUI). The user authentication feature of the application verifies the authorized users through login and password.

issue of contamination observing, wellbeing checking, vocation estimation, supportability evaluations and estimation related fields. The information's are naturally put away in the database; this data can be utilized by the experts to take brief activities. It additionally causes the typical individuals to think about the measure of contaminations in their general vicinity and to take control measures. This is a vigorous framework which is helpful in businesses due to the expanding contamination because of increment in ventures. This framework is easy to understand and cost of the item is reasonable. This framework is checking just five parameters and henceforth can be extended by considering more parameters that reason the contamination particularly by the ventures.

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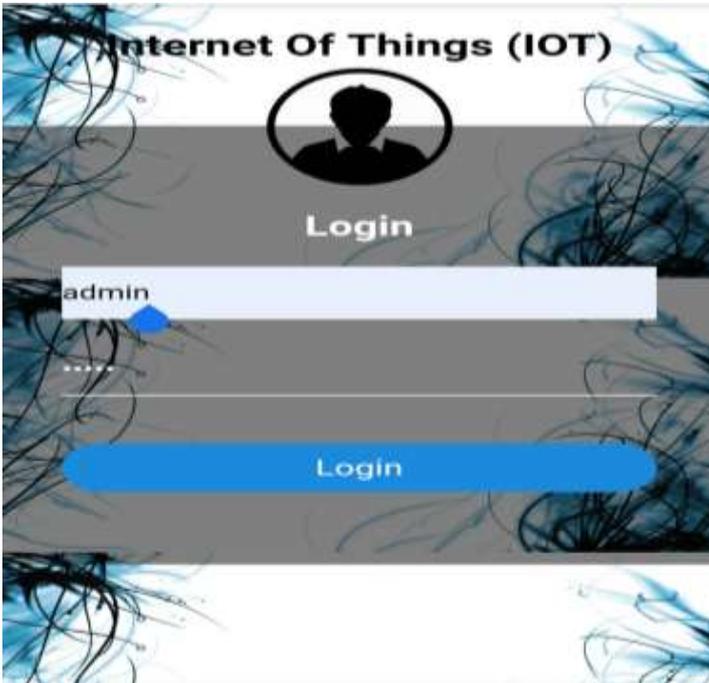


Fig -6: Mobile Application view



Fig -7: Mobile Application view of Data

### 7. CONCLUSION

The created air quality checking and perception framework precisely estimated the grouping of poisons carbon monoxide, carbon dioxide, smoke and residue in climate. The sensor has been coordinated with IoT structure which has proficiently been utilized to quantify and screen the contaminations continuously. This framework beats the

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