infrared optics gas detection was high in detection accuracy, long range service life. It the system allowed the passage of infrared signal to the gas intended for measurement while its molecules will absorb the light energy. The absorption relationship followed Lamber-Beer law.

In the year 2014, Soundarya, *et al,* stated that an efficient and smooth working controller is needed to continuously sense both leakage and level of the gas. And also fast response is required when leakage is found and the monitoring system must provide additional leakage information which can be used in further processing. The detection system includes Arduino duemilanove, microcontroller board compatible with ATmega328p coupled with the system is the weight sensor, LCD display, GSM and DC motor.

Chen and Jiang, (2008) designed and implemented a GSM-Based Remote Monitoring System. The paper focused on wireless monitoring because the wireless remote monitoring system has a wider application. The hardware and software architecture of the system was designed where the remote signal is transmitted through GSM network. The system has two parts: the monitoring centerand the remote monitoring station. The monitoring centerconsists of a computer and a TC35 communication module for GSM. The computer and the TC35 are connected by RS232. The remote monitoring station consist of a TC35 communication module for GSM, an MSP430F149 MCU, a display unit, sensors and a data gathering and processing unit. The software for the monitoring center and the remote monitoring station were designed using VB.

A review of gas leak detection techniques was done by (Puran G. et. al. 2014) with a classification of leak detection methods in a gas pipeline to monitor the integrity of a pipeline. In terms of mode of operation, (Soundarya ., *et al*, 2014) settled for the use an Arduino board, which is quite expensive and bulky. used microcontroller (PIC16F877), which in turn is a soft real time system. It is said that "A hard real time system should always respond to an event within the deadline or else the system fails and endangers human lives but in soft real time system, failing to meet the deadline produces false output and does endanger the human lives.

Devahema *et al*., (2018) in their survey noted that the level of pollution has increased with times by lot of factors like the increase in population, increased vehicle use, industrialization and urbanization which results in harmful effects on human wellbeing by directly affecting health of population exposed to it. In IOT Based Air Pollution Monitoring System the Air Quality is measured over a web server using internet and will trigger a alarm when the air quality goes down beyond a certain level, means when there are sufficient amount of harmful gases are present in the air like CO2, smoke , alcohol, benzene and NH3. It will show the air quality in PPM on the LCD and as well as on webpage so that we can monitor it very easily.MQ135 sensor which is the best choice for monitoring Air Quality as it can detects most harmful gases and can measure their amount accurately .The pollution level can be

monitored anywhere using computer or mobile. Install this system anywhere and can also trigger some device when pollution goes beyond some level, like it can switch on the Exhaust fan or can send alert

According to Pan and Zhu (2018), Dust, known as “airborne particles”, refers to solid particles that are suspended in air (diameter ≤ 100 μm). Among them, dust with diameter < 2.5 μm, known as “fine particulate matter”, is referred to as PM2.5. After being inhaled by the human body, PM2.5 can directly enter the blood through the bronchi and alveoli, which are phagocytized by macrophage. Their long-term stay in the alveoli exerts a negative impact on the human cardiovascular, nervous system, and other organs, posing a threat to people’s health. Consequently, indoor air quality has become a great concern.

Al Ahasan et al., (2018) stated that now-a-days air pollution is one of the most important concern of the world. Air pollution may evolve from anthropogenic or natural sources. Air pollutants of atmospheric substances like CO, CO2, SO2, NO2, and O3 suspended particulate matter (SPM), repairable suspended particulate matter (RSPM), and volatile organic compounds (VOCs) have a great effect on the people health. Most of the major cities in developing countries and most cities of the developed countries are suffering from it. Thus to develop a real time air quality and pollution monitoring system is critical. We have developed an Arduino based air pollution detector which combined a small-sized, minimum-cost sensor to an Arduino microcontroller unit. The advantages of the detector, have a reliable stability, rapid response recovery and long life features. It is affordable, user-friendly, low-cost and minimum-power requirement hardware which is appropriate for mobile measurement, as well as comprehensible data collection. It has a processing software able to analyze, collected quality data with high precision.

Husain *et al.,* (2016) In their paper a cost efficient, portable, easily manageable Arduino based device has been presented to monitor air quality. The device works by collecting data of quantity of specific harmful gases and the amount of dust present in the air. This device can be located at any place and the data can be transferred to an Android phone via Bluetooth or simply by connecting the device to a PC/laptop. Data collected by the device from different places can be later examined to make further decisions and analysis about the state of air quality; furthermore, it can also help concerned individuals to act upon it.

According to Karami *et a*l., (2018) building performance monitoring could be limited due to the cost and inflexibility of hardware and software platforms for data acquisition. This paper describes a portable continuous measurement toolbox which provides a robust, easily extendable, and low-cost

setup for indoor environmental quality (IEQ) monitoring and performance assessment. Various sensors—temperature, relative humidity, illuminance, CO2, VOC, PM2.5, and occupancy—for IEQ performance measurement are included in this toolbox. Arduino Uno boards were connected to the sensors for data acquisition. ZigBee communication protocol was established between an XBee device for each Arduino board and an XBee receiver connected to a computer. The toolbox utilized the open source, agent-based software platform for data communication and analysis. The data collection system was calibrated against an accurate data acquisition card. Experiments have been conducted using the toolbox for assessing IEQ performance in an open computer lab within a commercial building. Thermal comfort, indoor air quality, and lighting performance have been analyzed based on collected data. The study demonstrated reliability and robustness of the toolbox for continuous monitoring of indoor environmental quality.

Alvea *et al*., (2018) stated that Evidence shows that Smart Cities are starting to materialize in our lives through the gradual introduction of the Internet of Things (IoT) paradigm. In this scope, crowd sensing emerges as a powerful solution to address environmental monitoring, allowing to control air pollution levels in crowded urban areas in a distributed, collaborative, inexpensive and accurate manner. However, even though technology is already available, such environmental sensing devices have not yet reached consumers. In this paper, we present an analysis of candidate technologies for crowd sensing architectures, along with the requirements for empowering users with air monitoring capabilities. Specifically, we start by providing an overview of the most relevant IoT architectures and protocols. Then, we present the general design of an off-the-shelf mobile environmental sensor able to cope with air quality monitoring requirements; we explore different hardware options to develop the desired sensing unit using readily available devices, discussing the main technical issues associated with each option, thereby opening new opportunities in terms of environmental monitoring programs.
Vijayalakshimi *et al.* (2016) are of the opinion that “Real Time Weather Monitoring from Remote Location Using Raspberry pi” proposed a system for Real time weather monitoring using Raspberry pi, it measure various weather parameters like temperature, light intensity, atmospheric pressure, Gas/smoke level using appropriate sensors interfaced with Raspberry Pi, it uses wireless technology to provide real time data transfer. The project deals with designing a simple, highly efficient, cost effective and easy to operate Real time weather monitoring system. Using a database to raspberry pi this project can access from anywhere.

Rasal and Jaideep, (2016) in their research “Raspberry Pi Based Weather Monitoring System” proposed a system that visualizes the parameters of weather variables. To know the current weather condition at remote location this system is design for. Proposed System will visualize and store various weather

parameters as given above with the help of sensors interfaced to Raspberry will get all data, SD card on Pi stores the collected data as like memory card (Rasal, and Rana, 2010).

Gonçalo et al. (2015) in a work titled "An Intelligent Weather Station" presented an intelligent weather station for forecasting different variables of weather. To predict and analysis weather variables from anywhere. The hardware and software design of the implemented prototype are described the forecasting performance related to the three atmospheric variables, atmospheric pressure, humidity, temperature.

Vasantha and Basha, (2016) in a work titled "Weather Monitoring Using Raspberry Pi Viva Web Application" proposed an environment monitoring system. This system also capable of monitoring and control of environmental parameters like temperature, pressure and humidity. It also focused on low cost. This system uses Wireless sensor Networks for sensing the environment parameters in the area under supervision.

Natanael, *et al*. (2016), developed a low cost automated data acquisition system for urban sites temperature and humidity monitoring based in internet of things. This work produced an automated Data Acquisition system that communicates the interaction and interoperability of temperature and humidity sensors through the internet. Results proved that the use of internet of things improved the effectiveness of automatic decision making for the system.

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Fortes and Borba (2017). Design of Low Cost Multi Channel Data Acquisition System for Meteorological Application. A low cost multi-channel Data acquisition system was designed for acquiring temperature, humidity, barometric pressure, altitude and light intensity from the environment and stores the data in a PC for future use. The sensors are interfaced with ATmega328 which performs the acquisition function and data logging.

Ojike1 *et al* (2016). In this work, a low cost six- multipoint temperature data logger was developed. It was designed using LM35 as the sensor, and arduino Uno as the data processing element. The response time of the sensor was observed to be between three and four minutes. The comparative evaluation of the system with other established thermometers show that no two temperature meters gave the same values. However the most important thing is that all the systems recorded the same temperature flow pattern. This indicates that the systems actually senses change in the surrounding effectively. In relation to the alcohol thermometer, the designed system shows an accuracy of +0.4oC at temperatures below 300C and +1.850C at temperatures above 300C. The system gives room for effective and adjustable

Table 3 Summary of Literature Review

S/N	Author	Technology	Key feature	Limitations

temperature data logging procedure. Hence, the system is recommended for use in monitoring low temperature systems.

Najwa (2016) in his paper describes the design of a general data logger for Photovoltaic (PV) monitoring system that can store bulk data from input channels in large memory storage. It utilizes Arduino Mega 2560 board in conjunction with ATmega2560 chip. For monitoring the related parameters, a 240-W PV system is used where electrical parameters are tapped into the input channels of the data logger. The system will convert the acquired raw data to digital input for data acquisition and will store the data onto SD card. The data logger is also equipped with DS1307 Real Time Clock (RTC) chip for data stamping in the SD card every at the occurrence of the logging process. Results and findings are recorded and compared with the data that was taken by one commercial data logger DataTaker DT80 during the testing stage. This is to test the data reliability as well as to examine the performance of the proposed data logger throughout the testing process.

Mabrouki et al (2021) in their paper propose an automatic weather monitoring system that allows having dynamic and real-time climate data of a given area. The proposed system is based on the internet of things technology and embedded system. The system also includes electronic devices, sensors, and wireless technology. The main objective of this system is sensing the climate parameters, such as temperature, humidity, and existence of some gases, based on the sensors. The captured values can then be sent to remote applications or databases. Afterwards, the stored data can be visualized in graphics and tables form.

		Used		
1	Kelly. W, K. Kronfeld & T. Rand, (2000).	Radar	Weather Monitoring Systems that reads climate parameters	• Tremendous initial cost, noise and interference, propagation delay, time delay lessens. • No data logging System • No Gas pollution Detector
2	Xie Z. Tan Q. (2006)	infrared optics gas detection	high in detection accuracy, long range service life.	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No weather Station • No logging system
3	Chen and Jiang, (2008)	GSM	a GSM-Based Remote Monitoring System.	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No weather Station • No logging system
4	Kalsi S.P, (2008)	Satellite	Weather Monitoring Systems that reads climate parameters	• Tremendous initial cost, noise and interference, propagation delay, time delay lessens efficiency. • No data logging System • No Gas pollution Detector
5	Mettlach et. al, (2008)	Predictions	Weather Monitoring Systems	• Climate prediction correctness has been difficult to address. Fault prediction occurs due to climate changes. • No Logger • No Gas pollution Detector
6	Ashenafi and Haghani, (2014)	Wireless Sensor Network Based System	Weather Monitoring Systems that reads climate parameters	• Lower speed, less secure because programmer can read information like username and password • No data logging System • No Gas pollution Detector
7	Lo Conti, et. al. (2014)	GSM	Weather Monitoring Systems that reads climate parameters	• The limitations of this system are that it cannot be monitored remotely and requires the physical presence of the human being to take readings. • No data logging System • No Gas pollution Detector
8	Puran G. et. al. (2014)	Arduino Base	Gas leak detection System	• it cannot be monitored remotely and requires the physical presence of the human being to take readings. • No weather Station • No logging system
9	Soundarya, et al, (2014)	Arduino Base	Gas Linkage Detector and LCD Display	• it cannot be monitored remotely and requires the physical presence of the human being to take readings. • No weather Station • No logging system
10	Susmithan & Sowmyabala, (2014)	Micro-controller LPC1768	Weather Monitoring Systems	• No Logger • No Gas pollution Detector

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		MCU		
11	Karthik & SurajThapa, (2015)	Arduino	Weather Monitoring Systems	• Structure is drawback size should be as small as possible. • No Logger • No Gas pollution Detector
12	Mestre et al. (2015)	Raspberry Pi Based Weather Monitoring System	Raspberry Pi Based Weather Monitoring System for atmospheric pressure, humidity, temperature	• . it cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • 28No logging system
13	Nisha et. al, (2015)	Zigbee	that reads climate parameters	• Shorter range, lesser complexity, less information speed, high cost. • No Logger • No Gas pollution Detector
14	Husain et al., (2016)	Arduino and Android.	Air quality monitoring: with Bluetooth data logging	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • Single logging system
15	Madhuri P. Patiletal (2016)	GSM	Weather classified monitoring systems	• No data logging System • No Gas pollution Detector • it cannot be monitored remotely and requires the physical presence of the human being to take readings.
16	Najwa, Nasuha and Mahzan (2016)	Arduino Based Data Logger for Photovoltaic Monitoring System	Design and Development of an Arduino Based Data Logger for Photovoltaic Monitoring System on onto SD card.	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • Single logging system
17	O. Ojike1, Mbajiorgu, Anoliefo and Okonkwo4 (2016)	Arduino and LM35 sensor, Weather Data Acquisition System	Design and Analysis of A Multipoint Temperature Data logger.	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • Single logging system
18	Rasal and Jaideep (2016)	Raspberry Pi Based Weather Monitoring System	Raspberry Pi Based Weather Monitoring System" proposed a system that visualize the parameters of weather variables.	• it cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • No logging system
19	Shital M. Dharrao,et. al., (2016)	Camera	Weather Monitoring Systems	• For vertical photography which require clear sky, no cloud & is humped by strong thermal activity in the air. • No Logger • No Gas pollution Detector

20	Siddharthan & . Kasiraj, (2016)	Sensors and Arduino	Detection of Toxic Gases using Arduino and GSM Network	• No Logger • Weather Monitoring Systems • Single Sensor • No Logging System
22	Vasantha, and Basha, (2016)	Raspberry Pi Viva Web Application Weather Monitoring System	Monitoring Using Raspberry Pi Viva Web Application. capable of monitoring environmental parameters like temperature, pressure and humidity.	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • No logging system
23	Vasudev Yadav, Akhilesh Shukla et. al., (2016)	GSM,	LPG Gas leakage detector	• The limitations of this system are that it cannot be monitored remotely and requires the physical presence of the human being to take readings. • Single Gass sensor • No Logger • No weather monitoring system • No IoT reporting
24	Vijayalakshimi and Lakshmi (2016)	uses wireless technology Using Raspberry Pi	Real Time Weather Monitoring from Remote Location Using Raspberry Pi. To measure temperature, light intensity, atmospheric pressure, Gas/smoke	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • No logging system
25	Fortes and Borba (2017)	Arduino Weather Data Acquisition System	Design of Low Cost Multi Channel Data Acquisition System for temperature, humidity, barometric pressure	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • No logging system
26	Al Ahasan et al., (2018)	Arduino and volatile organic compounds VOCs sensor	Arduino-Based Real Time Air Quality and Pollution VOCs Monitoring System.	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Weather System • No logging system
27	Alvear (2018)	crowd sensing architectures, IoT architectures and protocols	crowd sensing architectures, IoT architectures and protocols	• Iit cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • Single logging system
28	Devahema et al., (2018)	IoT on Arduino , MQ 135 Senor,	IOT Based Air Pollution Monitoring System the Air Quality is measured over a web server, LCD Display	• Weather Monitoring Systems • Single Sensor
29	Karami, (2018)	Arduino and ZigBee	Real Time monitoring of indoor environmental quality using an Arduino-based and Open source, agent-based software platform for data communication.	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector • No logging system

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30	Pan and Zhu, (2018)	Sensors and Arduino	Air Quality and Dust Monitor Using Arduino	• It cannot be monitored remotely and requires the physical presence of the human being to take readings. • No Gas Detector, No logging system
31	Pritam Ghosh, Palash Kanti Dhar, (2019)	SMS alert	gas leakage detector	• The limitations of this system are that it cannot be monitored remotely and requires the physical presence of the human being to take readings. • Single Gas sensor • No Logger • No Weather Monitoring Systems
32	Chaudhary, Juhi & Mishra, Anurag, (2019)	Arduino Uno, MQ-6 Gas Sensor, LCD, LPG, Stepper Motor Driver, Buzzer, GSM mode	Detection of Gas Leakage and Automatic Alert System using Arduino	• Single Gass sensor • No Logger • Weather Monitoring Systems • No IoT reporting
33	Mabrouki et al., (2021)	Arduino IoT-Based Weather Monitoring	IoT-Based Data Logger for Weather Monitoring Using Arduino-Based Wireless Sensor Networks with Remote Graphical Application and Alerts	• Internet Failure causes system failure • No Gas Detector • No logging system

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.Summary and Conclusion

Although there are many advanced systems that might be able to monitor more atmospheric parameters, these systems usually generalize their measurements over a very large area, for instance, monitoring real time parameters for a metropolitan area or large suburbs using a few observation points. Our review also shows that the existing systems have the following lapses: (i) inability to automatically monitor multiple types of air quality parameters (Combustible and Toxic gases) at the same time monitor atmospheric conditions such as, temperature, humidity and heat Index. This makes getting the whole picture in terms of harmful particles, gases, temperature and humidity very difficult. (ii) Most of the existing systems do not have data logging facility, and they are design to be carried by individuals that has to retrieve or read and collect the data by themselves. This requires manual intervention and increases labor costs and the chance for mistakes. (iii) The IOT based wheatear forecasting systems on ground, possesses the ability to access information remotely through internet devices and websites, but connectivity is the major challenge. This is because in a situation of network failure such system becomes useless hence a standalone IOT system is equally prone to fault in data logging.

(iv) Furthermore, most of the atmospheric monitoring system provides only the present condition and readings of a particular field which will not provide past records of this particular environment, hence make it difficult for environmental inspectors to have an historical record of environmental conditions for proper assessment of the exact condition of a particular city or particular place. (v) Another main

problem in most of the existing system is the inability of giving alert signals whenever it encounters divergent issues. This imposes a very big risk of insecurity for users. Another issue with the existing system is that most of the devices have limited power supply. Power requirements are one of many major constraints as these instruments are generally sited far from main power supply. For sensors to work in the field, they must be electrically stable. If instruments are not kept charged, turning it on and using it without allowing the sensors to warm up will cause the instrument to give wrong readings some times. Replacing sensors with new sensors that have not been conditioned correctly will cause the same effect. When you respond to an emergency, you need all of your options immediately available, hence the lack of multiple power sources imitate most of the existing systems. Having done extensive review of the existing atmospheric monitoring systems, it is obvious that although many researches have been done in this area, more needed to be done in order to harmonize and reconcile the vulnerabilities in the existing atmospheric systems. This is because atmospheric pollution is an important issue that has severe effects and the effects of pollution are detrimental to the life and health both human beings and other living things.

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