www.irbas.academyirmbr.com July 2021
International Review of Basic and Applied Sciences Vol. 9 Issue.3

IoT Based Environment Analyzer

NAVEED ALI KHAN KAIM KHANI
Electrical Engineering, Federal Urdu University
Arts Science and Technology Islamabad, Pakistan.
Email: naveedali64@yahoo.fr
Tel: +923363235569

M. JUNAID FAZAL
Electrical Engineering, Federal Urdu University
Arts Science and Technology Islamabad, Pakistan.

USAMA ARIF
Electrical Engineering, Federal Urdu University
Arts Science and Technology Islamabad, Pakistan.

Abstract

In Asian nations including Pakistan, Afghanistan, India, air contamination is a significant and extreme natural issue. In these nations extremely poor air quality saw by a lion's share populace which causes plenty of medical problems like respiratory ailments, creating malignant growth, genuine infection, and trouble. So, the individuals like these who are now influenced or more delicate need to play it safe as per condition before venturing out to some point. The proposed scheme is divided into four stages: gathering information from sensors, measure information utilizing Arduino IDE, and send to the ESP8266 WIFI module, WIFI module sends this information to Firebase Cloud ID, an android application to takes all the information from firebase and give the client an interface to get to this information about environment condition with easy accessibility. The proposed framework manages to observe and controlling significant environmental conditions. Furthermore, presents the execution and result of this environment checking framework which utilizes the sensors for climate, stickiness, and environmental boundaries of the encompassing region. Collected information is sent to the cloud storage and a mobile application gets to the cloud and showcases the results to the end clients. That information can be utilized to perform far off activities to manage the state. This framework can be stuck out to an instrument, a home assistance framework via automatic setting off certain activities and manage different appliances depending on the screened values of temperature, humidity, and different parameters by the support of the cell phone application.

Keywords: *IOT's, Sensors, Arduino Controller, Wi-Fi Module, Firebase Cloud.*

Introduction

As per the "World Health Organization" review, about 200 deaths for every 100000 populaces are inferable from environmental components in Pakistan. As Pakistan falls inside the gathering of least created nations regarding the safety of the earth, advancing solid ways of life, and improving personal satisfaction. The state has built up a local arrangement and has offered help to create public techniques for health and the environment, Stratifying nations as per contrasts in states of environment and health. To beat every one of these kinds of environmental issues, the idea of smart cities appeared. Keen urban areas remember factors with a direct effect on the personal satisfaction and thriving of the city tenants. That empowers individuals to help one another in the acknowledgment of life capacities and the advancement of their most extreme latent. That strengthens the demand to make apparatuses to screen the territories and gather data. Where

sensors crisscross been utilized as a functioning exploration region since it has endless focal points predominantly because of the capability of their applications.

In this research, the utilization of wireless sensor networks for air contamination observing in the region. The issue is raised because of the contamination; air contamination is turning into a significant worry for the health with the developing industries process. Along these lines of world health organization is regarding environment investigation. The keen focus is that instruments designing should base on to perceive the environment by measuring its parameters and afterward share this data with the individuals for their advantage. Furthermore it is also in considering that all elements of human welfare based instrument develop which equip for estimating the environmental parameters like temperature, pollen, mugginess, noise, dust particles, Ultraviolet (UV) radiation, carbon monoxide, and particulate matter of specific point of some area and appropriately aware the individuals about environmental parameters of that place.

Literature Review

A project is designed and implemented an environmental monitoring scheme by IoT and Cloud overhaul at Real-Time by author Mukesh Ranjan. In their research paper, they clarify and present the usage and result of the environmental observing framework which utilizes the sensors for climate, dampness, and other environmental boundaries of the encompassing territory. The collected information is lead into the cloud storage and acquires into the cloud and presents the outcomes to the end-clients (Mukesh et al. 2019; Pablo & Lorenzo 2017). Furthermore, a low-cost IoT centered environmental observing network is discussed. Whereas, a resident approach to contamination responsiveness is focused. Actually, the framework can convey geo-tagged data and the condition of environmental contamination to the residents through MySQL database. In (Arunkumar, Ajaykanth, Ajithkannan & Sivasubramanian, 2018) a project is called smart air pollution espial and monitor with IOT. In their research paper, the proposed thought is examined by utilizing the contamination control circuit, to screen the air toxins transmitted by plenty of transports like all vehicles and industries and domestics. These normal and anomalous qualities are transmitted to Modem through the IoT. While, E.N.Ganesh is developed a framework known as IOT Based Environment Monitoring using Wireless Sensor Network in (Ganesh, 2017). Thus, they presented the useful plan and usage of a total WSN stage that can be utilized for a scope of long-term environmental observing IoT applications. Moreover, an intellectual agriculture greenhouse environment monitoring network is proposed by IOT Technology (Subahi & Bouazza, 2020; Mahajan, Badarla & Junnarkar, 2021). In (Saima et al.,2018) a real-time IoT depended environmental monitoring scheme is used with arduino and Cloud Services. There, arduino UNO low-cost Wi-Fi microchip (ESP8266) is used by providing the user an interface to storing all the collected data into the mobile application. Additionally, in (Monali & Komal, 2020) an IOT established scheme is proposed that is used for the weather monitoring system in which the sensors are maintaining all data with the help of Arduino Uno and then display all collected parameters on the LCD. In (Deekshath et al, 2018; Singh & Baz, 2021) IoT Based Environmental Monitoring System is discussed to observe the temperature and humidity of the surrounding area by sensors. Likewise, an arduino UNO used to deliver on thinkspeak portal for data monitoring and analysis. In (Sampathkumar et al, 2020) a Design of a Water atmosphere monitoring scheme based on sensor network is proposed.

Conversely, they developed a framework that monitors water hotness and pH rate of the lake automatically. Furthermore, a wireless sensor framework is used for monitoring data of every node. The data is transferred in database for monitoring and evaluation from remote areas.

Technology Background

The equipment with the technical specification that is utilized in fulfillment of the project are talked about in detail and the components specifications are also discussed. It likewise incorporates the detailed information of software and simulation tools that are utilized in finishing the task. We also discussed the Arduino module, Wi-fi module, and all the sensors in the hardware section. Further, we explain all the

software base work in which we discuss Firebase Cloud, Arduino IDE, and the android application used in the project. The components are used to well-designed the IOT based environment analyzer. The various types of hardware modules are put-upon such as sensors, controller, WiFi module, Data base and Android App. Here, we have elaborated in each factor in details with equipment efficiency.

Sensors

We used well up-gradate and performance efficiency based sensors like such as Temperature, Smoke, Humidity, Dust etc… Where each sensor performance is examined and choose according to the projects IOT based environment analyzer requirements.

1. **DHT22:** The DHT22 is a low-cost and normally use a digital climate and evaporation sensor (Ahmad & Surya, 2021). It goes along with a devoted NTC to measure heat and an 8-piece microcontroller to yield the approximation of climate and mugginess as serial data.

2. **MQ2:** MQ2 is the ordinarily utilized gas/smoke sensors in the MQ sensor arrangement. It's a metal oxide semiconductor (MOS) kind of smoke sensor likewise called "Chemi-resistors" as the identification depends on the variation of resistance of the sensing item whenever the smoke interacts with the substance (Gautam et al, 2021). The smoke gas sensor sends data regarding gas presence in the environment through its analog output pin and digital output pin to the Arduino controller through serial communication.

3. **FC37:** The FC-37 rain sensor is utilized to identify water, also can recognize the background working of the evaporation sensor (Kumari, Sakshi, Gosavi & Nagre, 2020). The rain sensor sends the status of the rain to the Arduino controller through serial communication. If Arduino serial monitors show '1' it means that the environment is clear and when it shows '0' that means, it's raining outside.

4. **GP2Y10:** GP2Y10 Dust Sensor utilizes a Sharp optics (Saraubon, Nuttapong & Natdanai,2021) detecting framework that identifies mirrored light of dust with an IR optics sensor. It can detect an extremely small granule, for example, cigarettes, and highlights low power utilization and high-resolution proportion. The infrared radiating diode and a phototransistor are corners to corner connected into this gadget. Particularly, reliable to distinguish fine molecules likewise cigarette. Moreover, can recognize fumes from house dust by the yield voltage.

Software Section

There is a long range of software available regarding app development and data base service. We selected tools according to projects requirements. The main factors in the selection to tools were accuracy in data storage and extraction. Furthermore, a fast and easy access developed between data base server and users.

Arduino IDE

Arduino Software IDE makes it simple to compose programs and transfer on the circuit in (Dhingra et al. ,2019; Weibao & Xiaojin,2021). It works on "Windows", "Mac OS X", and Linux. The scenario is written in java and dependent on processing and other open-source software. Furthermore, the Arduino integrated development environment is a cross-stage feature and its backend is built by using C and C++ language. Utilized to compose and transfer code to Arduino boards. In our case it is the heart of our project, we utilize this to process all data from all sensors and create a code to transfer this information to the NodeMCU ESP8266 module for further process.

Firebase Cloud

Firebase cloud is a real-time database that builds applications very quickly without overseeing the foundation (Hunnu & Shah,2018; Mallik et al, 2020). It gives you usefulness like analytics, databases, messaging, and crash reporting so you can move rapidly and focus on your clients. Firebase is based on Google framework and scales automatically, for even the biggest applications. It offers us one platform, with items that work better together. Firebase items work extraordinary exclusively yet share information and bits of knowledge, so they work far superior together. In our project, we use a firebase cloud id in which we store the current time data of node regarding environment parameters. All this run time data is transferred to Firebase cloud ID through the NodeMCU ESP8266 Wi-fi module. Further, this stored information from firebase can be transferred to some Application for user interface purposes.

MIT App Inventor

We discussed in this project that we will provide the client with the best interface to access all information regarding environmental parameters. So, we create an android application using MIT app inventor (Walter & Sherman, 2015; Pokress & Domínguez, 2013) for client easy accessibility. By which clients can undoubtedly get to this information at a single step. In this project, we create this android application through the MIT application designer. This application takes all information from the firebase cloud ID automatically and gives the client the best interface to know about these environmental parameters.

IoT Based Environment Analyzer Framework

The modular-based methodology will be followed so if a malfunctioning happens, the troubleshooting and repairing will be very straightforward. The developed model for building IoT based environment analyzer and the environmental monitoring node to be placed in the field as presented in Fig 1.

Figure 1: IoT Based Environment Analyzer Model

The various sensors are used to observe the environment condition such as Temperature, Smoke, Humidity, Dust etc… Whereas, the controller is used to collect the each sensor information and transfer at central data base by WiFi module.

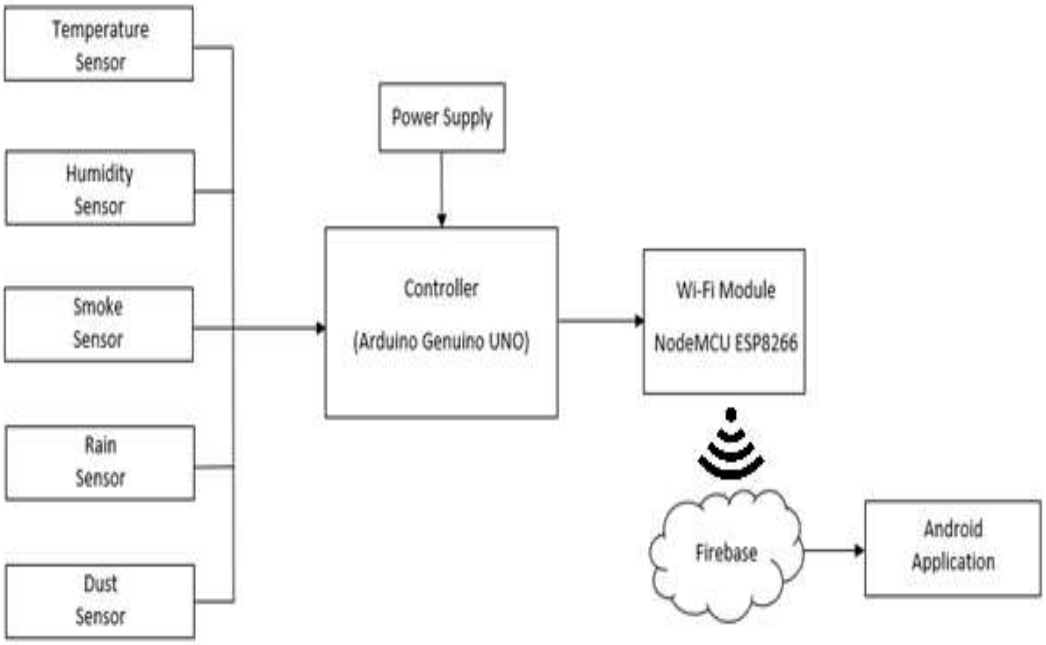


Figure 2: General Block Diagram of IoT Based Environment Analyzer

Furthermore, an andriod based applications is designed to monitor and analysis the sensors information for further necessary actions. The sensors blocks are shown in Fig.2 that is revealing the basic concept of the proposed strategy of IoT based environment Analyzer.

Initial blocks are represented the sensor operations and performance. The first two sensors blocks are used for temperature and humidity, in which the low-cost digital sensor DHT22 is used for temperature and humidity sensing. There another version that has been commonly used in above mentioned literature is known as DHT11. The both (DHT11 and DHT22) are cost effective and efficient in terms of performance. The main difference between DHT11 and DHT22 is measuring range of temperature and humidity. Whereas, the DHT22 has better efficiency in terms of measuring range of temperature between -40 - +125 ^{o}C with +-0.5 accuracy in degrees and humidity accuracy from 0 to 100% with 2-5% precision. Although, the temperature and humidity measuring range in DHT11is limited.

It is only able to observe the temperature from 0 to 50 ^{o}C with +-2 degrees precision and humidity precision lay between 20% - 80% with 5% accuracy. MQ2 sensor is useful to detect the GAS/SMOKE concentrations anyplace between 200 - 10000 parts per million (ppm). It is suited for detecting Smoke, Alcohol, LPG, Carbon Monoxide, Propane, Methane and Hydrogen. Furthermore, Rain is observed by FC-37 rain sensor. Whereas, Soil moisture is detected to forecast that it is dry or wet. Optical air quality sensor is used to observe the dust particles in atmosphere. The GP2Y10 dust sensor is used to detect the dust particles in polluted environment. After that, all these blocks are linked to the Arduino Uno controller for processing the data. It is an open-source smart microcontroller, which operate from external power for its I/O control operations. It collects all the data from sensor blocks to process and manage the data for further actions. Furthermore, a cheaper open source IoT framework Also known as NodeMCU ESP8266 is used for data transmission at remote location. Whereas, the processed data from the Arduino Uno controller is transferred on NodeMCU WiFi module to transmit the processed data bat the Firebase cloud service. In last, an android application designed which takes all the gathered information from the firebase cloud service and provides it to the user with a good interface for client easy accessibility.

This structure relies upon the remote transmission of natural components of intrigue, spatially circulated in the region, its administration, and capacity through a Cloud forum. This framework is characterized as an internet-dependent data obtaining framework. The working principle of the android App and data base is based on the collection of data from hardware comprises of sensors and Wi-Fi modules and with the assistance of the controller.

The control the present or past time information and afterward moves information to the cloud as elaborated in Fig 3. Further, this information from the firebase cloud can be taken by the Android application and give the client the best interface to get to this data.

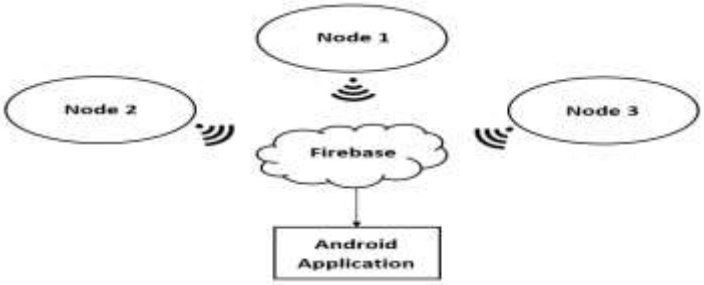


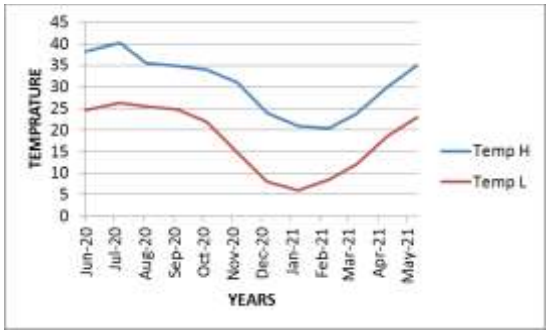
Figure 3: Block Diagram of hardware Interconnection

At first, hardware set-up is to be focused which incorporates the development of hardware devices, and all prototypes are being tested. In the event that any sort of breaking down happens, troubleshooting and fixing will be made in this stage.

Results Analysis and Discussion

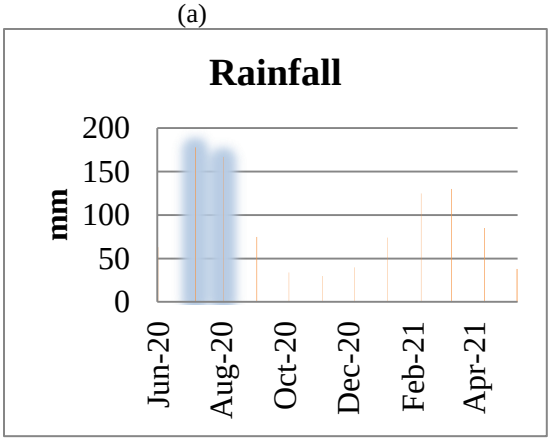
The outcome of the proposed strategy is designed a model and actualize an environmental analysis strategy that will distinguish the environmental parameters in a more effective way and gathers information about these environmental parameters of a specific point. Furthermore, it is provided the user with the best interface to access all this information about the environment. So, the outcome gather in the end is in the shape of a mobile application which provides a user an interface to access all information. Additionally, to get the parameters of a specific point, we must take the average of these nodes parameters to know the exact parameters of the point more accurately. There as, an option is given to verify the parameters of individually node by clicking on desired node as shown in the Figure 4.

Figure 4: Node 1 Node 2 Node 3 Node 4

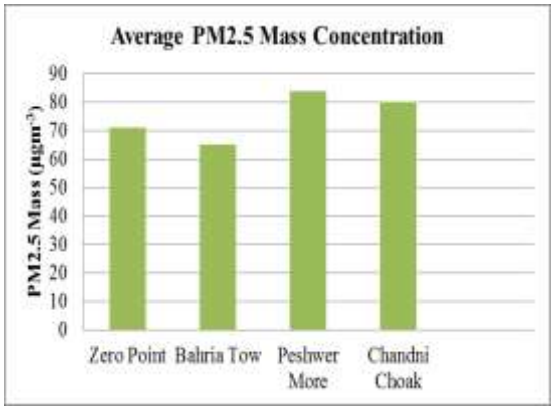


(a)

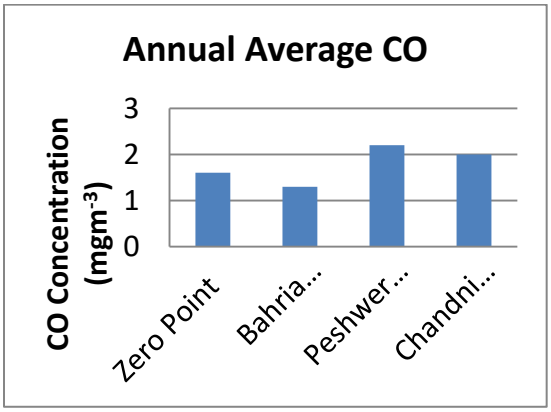
(b)



(c)



(d)



(e)

Figure 5: Results of air quality parameters observe for environment analysis

Description of Samples locations and Parameters

The capital city Islamabad is also known as twin cities (Rawalpindi and Islamabad) that is considered as semi-arid zone with warmly humid in summers subsequently rainy season and chill winter. The atmosphere is polluted due to Vehicular emission, Industrial Estate, Energy Production causes of air pollution in summer. The proposed scheme "IoT Based Environment Analyzer" is deployed at various locations of twin cities (Zero Point, Bahria Town, Peshwer More, Chandni Choak) was used for data collection. These locates were selected on the basis of prime area that mostly crowded with people and major source of contaminant.

The hourly based data of each contaminant area were collected and evaluated on the basis of average yearly. Whereas, the diurnal disparity and seasonal were also consider in background concentrations. The statistical norm yearly average absorption of contaminants in twin cities is computed for Temperature, Humidity, dust particles ($PM_{2.5}$), Gases (CO) and moisture (rain fall) concentrations are depicted in Figures 6a–6e. Whereas, the temperature is raised between the May to August in summer averagely. While, the chilly winter is ongoing from November till February. Furthermore, the peak monsoon duration is observed between July and August and bit mild rainfall is also noticed in March and April. The dust particles ($PM_{2.5}$) in atmosphere were observed at designated sites of the Islamabad and Rawalpindi. The uppermost average $PM_{2.5}$ values were detected in Peshawer More (84 µg m^{-3}) and Chandni Choak (84 µg m-3) due to congested area (Vehicle, Industry, Civil Construction etc..). However, the bit less effect of $PM_{2.5}$ was noted at the Zero point (69 µg m^{-3}) and Bahria town (63 µg m^{-3}) region because less congested and a small patch of greenery. The primary factor environmental variation is Carbon dioxide CO_2 also known as greenhouse gases (GHGs). Therefore, it is specifically significant to analyze the density of CO_2 in the air contentment. The large amount of CO_2 in air was observed at heavily busy and crowded area such as Peshawer more and Chandni Choak. The a bit better situation was observed around Zero Point and Bahria Town due to located near backwoods.

Conclusion

This proposed strategy is showing a real-time IoT dependent environment tracking framework for observation of the climate, mugginess, noise, Ultraviolet (UV) radiation, and particulate matter of the surrounding environment. It is also derived some significant information dependent on the climate information. The captured data is controlled and arranged by the utilization of an Arduino UNO controller. Later on, this information is sent through the NodeMCU ESP8266 module to the firebase ID. Furthermore, an application is developed for the clients to screen the environment. Likewise, a framework can utilize to send warnings utilizing a single tick IoT device regarding the present condition. This framework is the main point in understanding of IoT application evolution and execution. Additionally, it acts as a pillar for a few functional restructurings toward that field. Environmental sensor monitoring framework outfits a decent worldview for any automation system dependent on 'IoT'. Chiefly, it is engrossed on human welfare. In future, it can be modified in a way to get more precise values of specific point of environment parameters to face the issues like pollen and other diseases by sending the alerts. Furthermore, it can communicate using GPRS to show exact location and GSM technology to make data communication more efficient. Furthermore, the IOT based environment analyzer is useful in various applications of industry safety and environment monitoring organizations for health safety. Whereas, a precise observably system is required to monitor and shared the parameters with accuracy.

References

A. F. Subahi and K. E. Bouazza (2020), An Intelligent IoT-Based System Design for Controlling and Monitoring Greenhouse Temperature, in IEEE Access, vol. 8, pp. 125488-125500, 2020, doi: 10.1109/ACCESS.2020.3007955.

D.Arunkumar, K. Ajaykanth, M. Ajithkannan, and M. Sivasubramanian (2018), Smart air pollution detection and monitoring using IOT, *International Journal of Pure and Applied Mathematics*, Volume 119 No. 15 2018, 935-941

E. N. Ganesh (2017), IOT Based Environment Monitoring using Wireless Sensor Network, *International Journal of Advance Research Res*. 5(2), 964-970.

Gautam, A., Verma, G., Qamar, S. et al. (2021), Vehicle Pollution Monitoring, Control and Challan System Using MQ2 Sensor Based on Internet of Things. *Wireless Pers Commun* 116, 1071–1085 (2021). https://doi.org/10.1007/s11277-019-06936-4

Hunnu K. and Pritam S. (2018), Application of Firebase in Android App Development-A Study. *International Journal of Computer Applications* 179(46):49-53, June 2018.

Mahajan, H.B., Badarla, A. & Junnarkar, A.A. (2021), CL-IoT: cross-layer Internet of Things protocol for intelligent manufacturing of smart farming. *J Ambient Intell Human Comput* 12, 7777–7791. https://doi.org/10.1007/s12652-020-02502-0

Mallik, R., Hazarika, A.P., Ghosh Dastidar, S. et al. (2020), Development of An Android Application for Viewing Covid-19 Containment Zones and Monitoring Violators Who are Trespassing into It Using Firebase and Geofencing. *Trans Indian Natl. Acad. Eng*. 5, 163–179 (2020). https://doi.org/10.1007/s41403-020-00137-3

Monali M. S., Komal D. M., Ashwini D. K. (2020), IoT Based Weather Monitoring System". *International journal of research in engineering, science, and management*. Vol.3, issue-2.

Mukesh R. S., Muthu K. S., Sudha A., and Thirumalai N. D. P. (2019), Design and implementation of Environmental Monitoring System Using IoT and Cloud Service at Real-Time May 5, 2019.

N. Kumari, Sakshi, S. Gosavi and S. S. Nagre, "Real-Time Cloud based Weather Monitoring System, (2020) 2nd *International Conference on Innovative Mechanisms for Industry Applications (ICIMIA)*, pp. 25-29, doi: 10.1109/ICIMIA48430.2020.9074848.

Pablo V., Lorenzo V., Christian C. and Diego R. (2017), A low-cost IoT based Environmental Monitoring System. A citizen approach to pollution awareness, *Conference on Electrical, Electronics Engineering, Information and Communication Technologies (CHILECON)*, December 21, 2017.

Pokress, S. C., & Domínguez Veiga, J. J. (2013). MIT App Inventor. Enabling personal mobilecomputing Proceedings of Programming for Mobile and Touch, PRoMoTo 2013.

R. Deekshath, P. Dharanaya, K. R. Dimpil kabadia, G. Deepak Dinakaran, S. Shanthini. (2018), IoT Based Environmental Monitoring System using Arduino UNO and Thinkspeak". *International journal of science technology & engineering.* Vol. 4, issue 9.

S. Dhingra, R. B. Madda, A. H. Gandomi, R. Patan and M. Daneshmand (2019), Internet of Things Mobile–Air Pollution Monitoring System (IoT-Mobair), in *IEEE Internet of Things Journal*, vol. 6, no. 3, pp. 5577-5584, doi: 10.1109/JIOT.2019.2903821

Saima Zafar, Ghosia Miraj, Rajaa Baloch, Danish Murtaza, Khadija Arshad (2018), An IoT Based Real Time Environmental Monitoring System Using Arduino and Cloud Service". *Engineering Technology & applied science research* Vol.8, No. 4, 3238-3242.

Sampathkumar A., Murugan S., Elngar A.A., Garg L., Kanmani R., Malar A.C.J. (2020) A Novel Scheme for an IoT-Based Weather Monitoring System Using a Wireless Sensor Network : Integration of WSN and IoT for Smart Cities. EAI/ *Springer Innovations in Communication and Computing.* https://doi.org/10.1007/978-3-030-38516-3_10.

Saraubon, K., Nuttapong W., Natdanai T. (2021), Flashover Prevention System Using IoT and Machine Learning for Transmission and Distribution Lines, *International Journal of Interactive Mobile Technologies*, Vol. 15 Issue 11, p34-48. 15p.

Singh, R., Baz, M., Gehlot, A., Rashid, M., Khurana, M., Akram, S.V., Alshamrani, S.S., AlGhamdi, A.S. (2021) Water Quality Monitoring and Management of Building Water Tank Using Industrial Internet of Things. *Sustainability* 2021, 13, 8452. https://doi.org/10.3390/su13158452

Walter, D., & Sherman, M. (2015). Learning MIT App Inventor: A Hands-On Guide to Building Your Own Android Apps. Upper Saddle River, NJ, USA: Addison-Wesley.

Weibao G., Xiaojin L., Yiqun L., Yuping Z., Yue C. (2021), Development of an arduino-based integrated system for sensing of hydrogen peroxide, *Sensors and Actuators Reports*, Volume 3, 2021, https://doi.org/10.1016/j.snr.2021.100045.

Y. A. Ahmad, T. Surya Gunawan, H. Mansor, B. A. Hamida, A. F. Hishamudin and F. Arifin (2021), On the Evaluation of DHT22 Temperature Sensor for IoT Application," 2021 8th *International Conference on Computer and Communication Engineering (ICCCE)*, pp. 131-134, doi:10.1109/ICCCE50029.2021.9467147.