



POLLUTION MANAGEMENT THROUGH INTERNET OF THINGS: A SUBSTANTIAL SOLUTION FOR SOCIETY

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Abstract

Purpose of Study: In this age where population and industrialization have extended exponentially, contamination is a noteworthy emergency looked by humanity and essential measures ought to be taken to control it quickly. High levels of pollutants in the atmosphere, which are responsible for causing pollution that causes human heart problems, breathing and other all health problems to our society. This paper focused to provide a substantial solution to pollution in our society as a result of which major social, personal health and environmental pollution problems can be monitored and by taking effective steps they can be reduced.

Methodology: The proposed framework is an IOT unit for handling these issues, including powerful use of the different sensor, to capture the estimations of various sorts of toxins in the earth and show insights on a site which can be gotten to by all clients for nothing. The research data is collected from the different sensors installed at different locations in our surroundings. After collecting data from sensors, a comparative study of data is carried out with the standards provided by the Central Pollution Control Board (CPCB).

Results: The proposed system helps to reduce the pollution in our environment and as a result of which pollution can be reduced by taking major steps towards it.

Application/Implications: The framework we are proposing is a propelled answer for observing the ecological contamination at a specific spot and make data available for each person.

Novelty/originality of the study: Our proposed system ensures that pollution which ultimately causes health, environmental and other social problems can be tracked from time to time and each and every person in the society can track and check pollution level in their surroundings.

Keywords: *IoT, Arduino, WSN, CZE-15E sound sensor, ph-sensor, MQ-135 Gas-sensor, Pollutions, Health problems, Environmental Issues, Solution, CPCB, Social Problems.*

INTRODUCTION

The health effects of pollution are subject to intense study in recent years. Exposure to pollutants like mobile particulate matter and gas has been related to will increase in mortality and hospital admissions thanks to metabolic process and disorder. These effects are found in short studies, that relate everyday variations in pollution and health, and long studies, that have followed cohorts of exposed people over time. Effects are seen at terribly low levels of exposure, and it's unclear whether or not a threshold concentration exists for particulate and gases below that no effects on health seem. During this review, we have a tendency to discuss the proof for adverse effects on the health of designated air pollutants. ([Brunekreef and Holgate, 2002](#))

Water quality problems square measure a serious challenge that humanity is facing within the 21st century. Here, we have a tendency to review the most teams of marine contaminants, their effects on human health, and reach to mitigate pollution of fresh resources. Stress is placed on chemical pollution, significantly on inorganic and organic micro-pollutants as well as cytotoxic metals and metalloids similarly as oversized organic chemicals. Few aspects of waterborne diseases and also the imperative would like for improved sanitation in developing countries also are mentioned. The review presents current scientific advances to address the diversity of pollutants. It's organized on the various temporal and special scales of worldwide pollution. POPs (Persistent organic pollutants) have affected water systems on a worldwide scale for over 5 decades; throughout those points, anthropogenous pollutants, mining operations, and unsafe waste sites are the foremost main sources of semi-permanent regional and native pollution. Agricultural chemicals and wastewater sources exert shorter-term effects on regional to native scales.

Fundamentally, contamination influences people and our condition specifically or by implication. Beforehand, ecological contamination was not a basic issue but rather because of urbanization and industrialization, the contamination in nature has climbed all of a sudden and it ought to be controlled as quickly as time permits. To handle this issue, the ecological contamination checking framework is an excellent methodology by using it we can watch and concentrate on the state of condition. ([Owa, 2013](#)) With the help of sensors, the purposed framework can track the impacts and dimensions of contamination in the area. All the parameters and readings are sent to a computer server and showed on the site to open a

sorted out path for legitimate comprehension. At first, most frameworks comprised of just a single sensor equipped for observing just single parameters and such frameworks were just kept to screen either air ([Anjaiah et al., 2013](#)), water or sound contaminations. Additionally, because of the set number of settled checking destinations and confinements like size, cost and information goals made them complex to survey the viability of contamination reduction procedure.

THE OBJECTIVE OF THE STUDY

Our objective is to execute an ecological contamination checking framework that empowers to screen the parameters of contamination of water, air, and sound and record this information to the web-based computer server. It will give information in sorted out approach to open and help spread mindfulness in this battle with contaminations. The decrease in contamination is extremely fundamental for a superior future. ([Schwarzenbach et al., 2010](#))

LITERATURE REVIEW

[B. H. Sudantha, Nihal Kularatna](#) (2008) conferred a monitoring framework that controls and monitors surrounding air-contamination in '2008', consisting of a couple of sensors and a unit of the microcontroller to control and sense pollutant. And a user interface was provided on their personal computer to show data in graphical form also.

[P. M. B Silva, J.M. Dias Girao and O. A. Postolache](#) (2009) presented a smart sensor network for monitoring air quality. It was designed for both outdoor and indoor monitoring to environmental air pollutants. A central unit was used to control Sensors remotely which were installed in different rooms. Sensors conjointly calculated the temperature and wetness and concentration within the close area for accuracy. The Communication between sensors, central unit and server took place by victimization WiFi.

[Y. K. Lee and Y. J. Jung](#) (2008) implemented a monitoring system for the air pollution monitoring system that contains a Geo-sensor network. This research paper presents a model of flexible sampling and interval changes were introduced for increasing the battery lifetime. It displayed the data accordingly by monitoring the level of pollutions in areas.

([Firdaus and Ahmad, 2010](#)) conducted his study on Noise pollution, in urban territorial development, maybe a major issue at intervals the city, the third-largest urban center of the Republic of India. Environmental pollution has been increasing day by day. This study reviews the information on sources, intensity and health implications of pollutants collected through family survey pattern questionnaires from a try of utterly totally different denseness areas; one from the terribly high-density house and another from terribly denseness house. The analysis shows that a prime increase in population, industrial activities, ungoverned growth in traffic and quickly dynamic life vogue unit the key factors that have created and exasperate the matter of pollution among the study locations. The key health problems embody annoyance, disturbance in sleep, interference with communication and totally different harmful effects. With the utilization of statistical procedures, the cause and impact relationships between the intensity of pollution and the prevalence of diseases among sampled households of the city have been established by this study. Some suggestions like land use and transportation turning out with area units given throughout this paper for mitigating and managing the pollution drawback among the property urban development views.

[Mollinga, Peter P.](#) (2010) provides a method known as transdisciplinary for water pollution and its prevention. In this paper the researcher design a transdisciplinary research program or a project, with ZEF's initiative taken on water pollution and its effect on Human Health.

[Savale P. A.](#) (2014), Provide a review of the Effects of Noise Pollution on Human Being and its prevention and control. In this paper, the researcher measures Noise Pollution from different types of equipment like the dB scale, etc. The researcher concluded that Noise pollution must be controlled and prevented by the use of various effective techniques at the source itself depending on today's requirements.

[Joshua Nizel Halder, M. Nazrul Islam,](#) (2015) implemented research on the pollution in river water which aims at water pollution and its effect on human health. The research on the effect of water pollution on human health like yellow fever, dengue, various skin problems, etc.

[Himandri, S. Supritam Audi & Avimita Chatteergee,](#) (2017) in their study pollution control of the internet of things (IoT) and found that developing different types of sensors can detect the problem earlier and the solution could be possible without damaging the environment.

[Singh, G., Dubey, O. P., & Kumar, G.](#) (2018) implemented a solution to the sensor's wireless network that shows how sensors work and communicate and send data. The authors also guided how to install different sensors properly and how to protect those sensors from different wireless sensors attacks.

PROPOSED FRAMEWORK OF RESEARCH

The primary point is to build a unit that can be introduced in the required area for checking. The unit will fundamentally incorporate Arduino, sensors will be designed on it and WiFi module for information exchange. Gather the individual contamination readings after a certain time interim. Each and every recorded reading by the pack will be exchanged to the base stations (servers) by the WiFi module.

Readings from every one of the packs will be captured and save in the database at the server. Representation of gathering information from the distinctive area is finished utilizing measurable and easy to understand techniques, for example: in the form of line charts and tables. A site will spread the contamination information gathered by every one of the sensors, diverse hues will be designated for various scopes of contamination definitively to give a thought regarding the dimension of contamination. (Kumar, G., Singh, G., Bhatnagar, V., & Jyoti, K. (2019))

Numbers of reports are done every week on a standard interim and furthermore, constant notices are sent by fitting specialists when the contamination level surpasses the ordinary range limit esteem.

Basic Hardware Specifications

In instrumentation determination, the elements for the projected framework are various sensors, Arduino, WiFi module. Sensors of three types are used for checking the distinctive sorts of contamination. The WiFi module is employed to send the knowledge gathered by the distinctive sensors to the first server.

Because of marginal effort, straightforward interface, conservativeness, and capability to keep company with totally different gadgets, Arduino-UNO was chosen as a basic controller. The PCB highlights 14 digital pins and 6 analog pins. It works at 5.0V with data voltage running from 8.0-20.0V. Arduino has 2KB SRAM (Static Random Access Memory) and 32 KB Aboard Glimmer Memory that makes it terribly fast and effective. ATmega328 could be an MCU having an area from the AVR family; Arduino is associate degree it eight-bit device henceforward its inner registers and data transport engineering will house 8 information signs parallel all the whereas.

The WiFi Module could be a framework on give that TCP/IP convention stack is incorporated with the tip goal which will give microcontroller access to any accessible WiFi. The WiFi Module is employed for facilitating associate degree application or it will offload all parts of WiFi organizing from another computer processor. AT directions are used to program the WiFi Module. A program in AT directions consists to associate the WiFi Module to the Arduino device. The WiFi Module is incredibly financially savvy.

Our unit is using three distinctive sensors. To perceptible the air contamination (Zualkernan et al, 2010), the MQ-135 gas devices were employed. In fresh air, the MQ-135 Module device has a less physical phenomenon. The physical phenomenon of the MQ-135 gas device is higher aboard the gas focus within the encompassing condition rises. Convert amendment of physical phenomenon to check yield flag of gas focus. MQ-135 gas device exceptionally reaches to Sulphide (S₂) Benzene (C₆H₆) and Ammonia (NH₃). MQ-135 likewise detects the smoke and totally different risky gases within the encompassing. It upgrades the framework's capability to screen contamination to an instant level. A CZN-15E is the secondary sensor. It is a microphone based Sound Sensor which is utilized for observation of Sound contamination. The CZN-15E is utilized to distinguish the sound powers in the encompassing. CZN-15E has a movable potentiometer. It may be very well utilized to amend the trigger dimension at which we need the sound to be distinguished. It gives yield in regards to the sound power in the encompassing.

Basic Software Specification

A program is needed for the microcontroller to figure and execute the procedure connected with the planned structure. Arduino written computer programs are used to program and execute the planned framework. Arduino IDE provides the expected condition to the running of the program. Numerous styles of codes are utilized for numerous sorts of sensors within the Arduino IDE. (Boer et al, 1998)(Yanpeng et al, 2018)

To form the website HTML is used, to indicate the checked information from the sensors. CSS joined with hypertext mark-up language is used to form that website with diagrammatically UI, which is simple to a common man. (Martenes et al, 2015)

PHP code is used to recover info from the unit and after it is utilized to store determined information into the database. Structured Query Language (SQL) is used to form and keep up that information. PHP is likewise want to send info to the location for showing. (Egmond, et al., 1998)

Implementation Flow

Figure 1, represents the execution flow of the framework. Later the sensors working was been checked; else, they are rebooted like clockwork interim. The information collected by each sensor is sent to the server by means of the WiFi modules. On the server-side, a legitimate examination of the captured readings is done to comprehend the measure of contaminations in particular regions. Once every one of the information is investigated it is shown on a site to make it accessible to the ordinary citizens, to make them mindful of the contamination around them. This procedure is rehased after each 2-minute interim. On the off chance that whenever the contamination edge esteem is crossed a notice is shown on the site to make individuals mindful of the dirtied region.

RESULTS AND ANALYSIS

Implementation Details

In our proposed framework (figure 1), three sensors (CZN-15E sound sensors, MQ135 gas sensors, water sensors) and WiFi modules are connected with the Arduino-UNO microcontroller. The three sensors screen the contamination esteems in the earth, accumulate the perusing and the qualities are then shown on the sequential screen of Arduino IDE. From that point, the information is then sent to the server with the use of PHP to the server. Arduino IDE vital for usage is serviceable on an assortment of operating frameworks such as Linux and Windows. (Tsow, et al, 2009)(Yonglong et al, 2018)

The site where information for people, in general, will be demonstrated was made utilizing HTML and CSS. The site will get persistent information from the server in ordinary interims and showing the information to the general society. The database was made and overseen by SQL and it put away every one of the information observed by the sensors. (Panagopoulos, et al (2012))(Effendi, 2016)(Adams and Kanaroglou, 2016)

In figure 2, Arduino gathers information from distinctive sensors. The sensors situated in better places gather contamination subtleties in the encompassing of the unit. These sensor readings are then sent to the server with the assistance of the WiFi module. These readings are shown on a site with the use of PHP. On the off chance that the qualities gotten by the sensors are in the typical range, at that point they are shown in green shading color on the site. In the event that the sensor readings surpass the limit esteem set by the administration, at that point every one of those qualities is shown in red on the site. Week by week outlines and diagrams are plotted and showed on the site demonstrating the contamination levels at various times of the week. (Ruzol, et al, 2017) (Tsow et al 2009, S. Kumar et al. 2013)

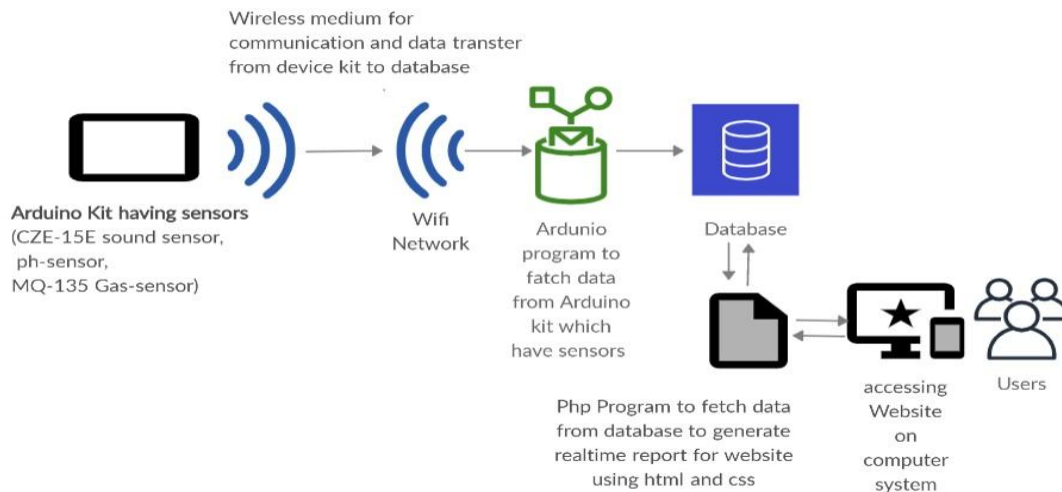


Figure 1: Implementation flow of the proposed system
 Source: Self-proposed

In a specific zone in the event that the contamination level is passed the edge esteem constantly, at that point an alarm message is shown on the site, so as to make individuals mindful of very dirtied zones. Along these lines, everyday citizens will think about the contamination levels and their environment (G. Lehmann et al., 2010)(Prashant et al, 2015).

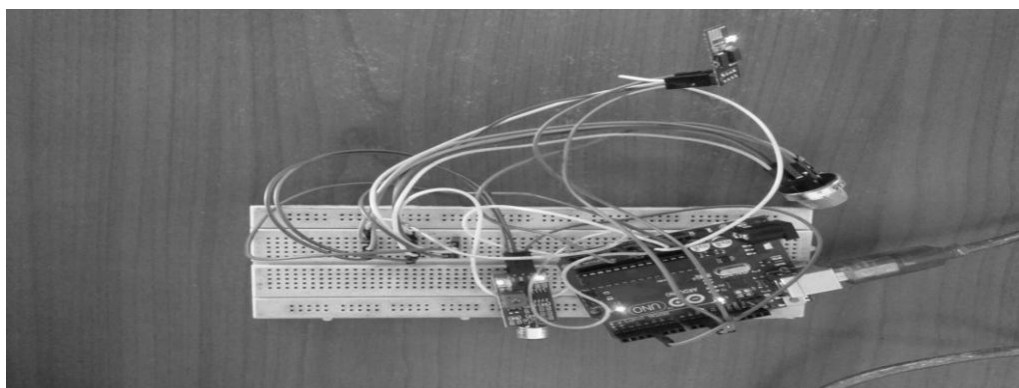


Figure 2: The proposed system
 Source: Self-proposed

The results show (figure 3) that each and every individual in our society can track and check the contamination levels of their surroundings by just logging to the PHP page or this data can be assessed to their smart devices where they can view

the pollution matrices date wise, months wise and yearly. As a result of which people are aware of the pollution level in their surroundings and can take major steps to reduce it.

Arduino ID	Kit Location	Gas Sensor	Sound Sensor	Water Sensor	Time	Date	Month
ID_01	KL_1	20	48	10	10:28 am	15/04/2019	April
ID_02	KL_2	23	45	13	10:33 am	15/04/2019	April
ID_03	KL_3	18	42	18	10:37 am	15/04/2019	April
ID_04	KL_4	90	120	20	06:30 pm	15/04/2019	April
ID_05	KL_5	25	43	16	11:00 am	15/04/2019	April
ID_06	KL_6	19	21	14	06:35 am	15/04/2019	April

Figure 3: Website displaying pollution details

Source: Result of the proposed system

Table 1: Ambient Air and Noise Pollution Levels - Deepawali 2011

Ambient Noise Level at different places in Delhi during Normal & Deepawali days in the year 2010 and 2011 Sl. No.	Location	Average Noise Level in dB (A) Leq.				
		Normal Day (Pre- Deepawali)		Deepawali Day	Max. Prescribed Limit	
		2010	2011	2010	2011	
01.	Lajpat Nagar (R)	3	67	76	81	55
02.	East Arjun Nagar (R)	NM	57	NM	74	
03.	Mayur Vihar Phase – II (R)	63	79	85	91	
04.	Pitam Pura (R)	58	58	71	75	
05.	Kamla Nagar (R)	56	58	81	81 =	
06.	Dilshad Garden (R)	56	56	83	80	
07.	Ansari Nagar (R)	58	56	81	76	
08.	Connaught Place (C)	62	64	71	69	65
09.	I.T.O (C)	65	72	71	71 =	

Source: https://www.cpcb.nic.in/noise_data/Deepawali-2011.pdf

When we compare the results, which are provided by the Central Pollution Control Board (CPCB) at the time of the Diwali festival from 2010-2011(table 1) and our proposed system data (figure 3). We can easily conclude that current pollution rates are increasing dynamically.

CONCLUSION

The proposed pollution checking system is a solution to the various pollution problems occurs in our society. The proposed system makes enable every individual to check and identify the pollution to their nearby surrounding. This architecture is a new innovation to fight with the social problem i.e. pollution in the environment. It underpins the new innovation and successfully bolsters the sound life idea. Individuals can see the week after week insights of the contamination in their environment. This will enable them to know about when the contamination around their encompassing is most noteworthy and can attempt to maintain a strategic distance from it.

This system turns out to be entirely dependable and effective for the Municipal authorities alongside the Civilians to screen conditions. Letting regular folks too associated with this procedure increases the value of it. As regular folks are presently similarly mindful and inquisitive about the condition, this idea of IoT is valuable for the welfare of the general public just as it is executed utilizing the most recent innovation with a low implementation cost.

LIMITATIONS AND STUDY FORWARD

The major limitation of this research is its implementation cost of the proposed system in a little high. And it's also very complex and maintains different sensors that sense and transmit data from different allocation of society or surroundings. In the future, we will introduce an Android Application for the proposed system to check the pollution statics over mobile devices.

TECHNICAL/PRACTICAL APPLICATION OF THE STUDY

The proposed system can be implemented in our society, surrounding environments, industries, colleges, universities and other public places so that we can aware of pollutions rates.

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