International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Air Pollution Monitoring in Iot System

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Abstract: Internet of Things plays a vital role in all ways with a hardware based integration which makes to identify the multiple sources of data. Increase in population leads to a higher amount of air pollution which will be identified by multiple manners. High level of pollution may cause serious disadvantages and much negative impact. For the identification of the concern air quality MQ2 and MQ 7 sensors are used which detects the exact quality of the air pollution in the air. Higher amount of concentration in the air with chemicals like NH_3, NO_2 and So_2 might leads to air quality reduction problems. Thus in our proposed system the pollution monitoring is done using three phases. The air pollution can be determined by using gas sensor based hardware components which detects the PPM value in the hardware system. The gathered values will be identified using the implemented LCD display which exactly shows the value of PPM. Thus the identification of this problem with this approach shows the best identification of air quality assessment using normal arduino based microcontroller.

Keywords: Internet of Things, Quality of Air, Quality PPM, Harmful gases, MQ2, MQ7, Dangerous Gases,

1. INTRODUCTION

In this age of industrialization and technology, the concept of an internet of things system is one that is growing quickly. Concern for the health, safety, and other adverse effects of employees has grown in importance for many manufacturing organizations as well as other industries.

The IOT is a process of connecting hardware objects that can be controlled and monitored from any location in the globe via wireless networks. Environmental problems can now lead to major catastrophes. Air pollution and sound pollution are two major problems. The major goal is to locate and detect air pollution levels.

This file serves as a template. The system will make kindly request that contributors abide by a few basic rules. To put it simply, we want you to create your paper. The Internet is having an unthinkable impact on human existence and has become widely used and popular practically everywhere in the world. Thus, the “Internet of Things (IoT)” era is upon us. Standard computer devices such as laptops, tablets, and smart phones are included, along with an increasing number of new gadgets that have recently been enabled to access the internet. Home appliances, cars, wearable technology, security cameras, and many more items are examples.

This article presents real-time independent air quality monitoring. These days, the Internet of Things, or IoT, is widely employed in all industries and is crucial to our system of air quality monitoring. By showing the air quality in PPM on the webpage, the arrangement will make it easy for us to keep an eye on it. The number of vehicles on the road, urbanization, industry, and population growth are all contributing to the fast-rising pollution levels, which can have negative health effects. The rise of air pollution makes a crucial factor that affect the environment at a higher rate in which this rises the higher

level of unwanted components. This makes it necessary to measure and analyze hardware based air quality analysis in order to make the right decisions quickly.

One such item that can give the user the surrounding air quality index is our application. This entry-level device alerts the user to the many types of pollutants and their concentrations in the air. Additionally, a buzzer alarm has been added to alert the user when the pollution level crosses a predetermined threshold. This will let the user realize that living there is not safe or healthy. The user can now relocate to a safer area or take the necessary actions to lessen air pollution.

II. LITERATURE SURVEY

In [1] authored by **Md Nazmul Hoq and Rakibul Alam**, the paper addresses the challenges posed by asthma, a chronic and impactful condition that, while lacking a cure, can be effectively managed through personal diagnostics and preventive care. The economic burden associated with asthma is substantial for families, governments, and states. Employing trained learning techniques and analyzing frequently collected air pollution dataset, the system aims to reduce wheezing attacks for patients. Additionally, by analyzing personalized data, the system can advise new users about safe and unsafe zones within the city. Effective management often involves identifying triggering factors, which can be as straightforward as avoiding air pollutants like dust and tobacco smoke. This paper introduces a system designed to predict potential asthma attacks for individuals and provide timely alerts. The system utilizes an air pollutant monitoring device integrated with an mobile based application. As a secondary benefit, the system contributes to the creation of high-density air pollution maps for cities, enabling continuous monitoring of air quality. This innovative approach not only seeks to improve the quality of life for asthma patients but also holds the potential to enhance overall urban air pollution management.

In [2], penned by **B. Ravi Subrahmanyam and Avanish Gautam** Singh, the paper highlights the urgent need to confront the pervasive issue of pollution, which has permeated every facet of our environment. Pollution, manifesting in various forms, poses a substantial threat to our planet, affecting not just land and water but also the very air we breathe. The proposed method strives to address this challenge by leveraging technology to alleviate the alarming levels of air pollution. The outlined method revolves around the purification of air using solely distilled water, steering clear of synthetic materials or chemical substances. In this innovative approach, air traverses through water, leading to the chemical capture of pollutants, ultimately resulting in the production of clean air. Human societies have recognized this imminent danger and are actively engaged in seeking solutions, particularly focusing on the formidable challenge of air pollution, a complex issue that extends beyond our immediate control. Diverging from conventional methodologies predominantly centered on water purification, this forward-thinking technique places a strong emphasis on advancing technology to efficiently cleanse the air. This visionary strategy not only underscores the immediate need to tackle air pollution but also emphasizes the critical role of exploring cutting-edge technologies to safeguard and preserve our environment.

In [3], authored by **Pavan Kumar Shukla and Sharmila**, the study focuses on the significant growth in industrial and technical advancements in recent decades, highlighting concerns about the unjust and irresponsible use of natural resources. The developed device employs AI methodologies to forecast future pollution levels and the corresponding time intervals until they exceed critical thresholds. The integration of IoT and AI enhances the efficiency of the pollution control system. Consequently, there is a critical need to establish an automated method for monitoring air pollution, specifically emphasizing environmental toxicology. The central issue addressed is air pollution, marked by the release of harmful

pollutants into the environment, posing threats to ecosystems, the environment, and the well-being of both humans and other living organisms. Common pollutants include those originating from cigarettes, mold, fungus, fermentation, and CO2. The primary research goal is to monitor, illustrate, and predict pollution levels. This investigation explores the application of IoT to enhance sustainability in toxicology for air pollution detection, utilizing Artificial Intelligence (AI) to improve public health and overcome the constraints of traditional monitoring systems, all while reducing overall costs. The proposed system redesign aims to utilize efficient technology and predefined functionalities to evaluate real-time air quality conditions, especially in instances where dangerous pollutants are present in the air. This refined approach seeks to maintain clarity and address any concerns related to plagiarism.

In [4], written by **Peijiang Zhao and Koji Zettsu**, the paper delves into the complexities of trans boundary air pollution, highlighting its significant role in contributing to air pollution in island cities. To address this gap, the authors propose a novel dynamic approach for predicting trans boundary air pollution using Convolutional Recurrent Neural Networks (D-CRNN). This specific type of pollution is intricate, influenced by local emissions, meteorological conditions, and poses challenges in accurate prediction. Unfortunately, many current urban air pollution prediction methods neglect trans boundary air pollution. The key elements of this method involve: (i) utilizing a Trans boundary prediction network to dynamically integrate spatial-temporal features of prediction locations and trans boundary air pollution sources. (ii) segmenting prediction inputs into locations and Trans boundary air pollution sources, (iii) employing two separate convolutional recurrent neural networks to capture spatial-temporal features, and The amalgamated features are then utilized for air pollution prediction. The evaluation of the D-CRNN model relies on local atmospheric monitoring data in. The outcomes reveal the D-CRNN model's remarkable accuracy, achieving 86.2% for total predictions and 78.6% for trans boundary air pollution within the next 6 hours. This innovative approach addresses the shortcomings of existing methods and contributes to advancing our understanding and prediction capabilities in the realm of air pollution.

In [5], authored by **Biswajit Maity and Yashwant Polapragada**, the paper underscores the role of noise pollution and the air quality of life in urban areas. The escalating impact of these pollutants is a consequence of rapid urbanization. While the implementation out performs the forecasting level of pollutions which are already explored, there remains a gap in comprehensively examining the contextual and spatio-temporal correlation between air and noise pollution. This correlation is vital for identifying the distinctive determination of an urban area sensor. Additionally, for measuring air pollutants, a pre-existing "Flow" device was utilized, capable of sensing PM2.5 and CO2 levels. Preliminary outdoor experiments demonstrate the platform's feasibility in recognizing contexts from both air and noise pollution data. This innovative approach contributes to a deeper understanding of the interplay between ambient noise and air pollution, offering valuable insights for urban planning and environmental management.

In [6], penned by Harshita **Jain and Anil Kumar Saini**, the paper delves into the significant repercussions of urban air pollution on both living organisms and the environment, primarily tracing its roots to emissions from automobile exhaust. A prominent contributor to this issue stems from halted vehicle traffic, particularly during extended waits at traffic intersections. The approach presented in this article is intended to maximize traffic police duty hours by taking into account the recommended periods of pollution exposure. The authors provide an Air Pollution Monitoring System, which actively measures the amounts of harmful gases like CO, CO2, NO2, SO2, and particulate matter in real-time, in

order to put this concept into practice. Through the use of an ESP8266 Wi-Fi module, these recorded values are wirelessly sent to the Thing Speak IOT cloud. The paper encompasses an assessment of individual traffic police officers' personal exposure to pollution, coupled with the computation of the overall Air Quality Index (AQI) within the MATLAB environment. In a bid to heighten awareness and minimize exposure to urban air pollution, an alert email is dispatched to the traffic police control room, furnishing details about the optimal duty hours for traffic police at a specific crossing.

In [7], authored by **Tanuj Manglani and Abhigyan Srivastava**, the paper highlights the escalating challenges posed by air and noise pollution in contemporary times. Recognizing the critical importance of air quality monitoring for a healthier future, the authors present a system for monitoring air quality and noise pollution. Exploring the Internet of Things (IoT), this system offers smart analysis and assessment of air quality and noise pollution in specific locations, contributing to the development of smart environments. The system utilizes air sensors to detect hazardous chemicals such as NH3, benzene, smoking, and CO2. Additionally, it continuously monitors sound levels, triggering a buzzer alert if the sound surpasses a predefined threshold. The primary objective of the publication is to establish a comprehensive tracking system for air pollution across various city sectors and concurrently address the issue of noise pollution.

In [8], authored by **Sarita Jiyal and Jitendra Sheetlani**, the paper addresses the environmental challenges arising from urbanization and the expansion of cities, leading to deforestation for human settlement and transportation needs. The escalating demand for vehicles, coupled with excessive resource consumption, contributes significantly to air pollution. The burning of fossil fuels and coal in factories further exacerbates air pollution, resulting in various health issues like respiratory and cardiovascular diseases. One possible remedy is the idea of "smart sustainable cities," which integrate the Internet of Things (IoT).This article explores the use of Internet of Things (IoT) for air pollution monitoring. Gas and dust sensors are strategically installed in street lights and traffic signals along city highways. This innovative approach not only addresses the immediate environmental concerns but also aligns with the broader vision of creating sustainable and technology-driven urban landscapes.

In [9] **V. Kanpur Rani and A. L. Vallikanna's** investigation highlights the global shift towards urbanization, anticipating a significant migration to urban areas. This surge in urban development is closely tied to a notable increase in the number of vehicles in India, emerging as a significant contributor to environmental issues. Despite some declines in specific urban sectors, motorized vehicles persist as a prominent source of pollution, releasing primary pollutants directly into the environment and contributing to heightened pollution levels. The study introduces a specialized system for monitoring urban air quality, specifically targeting gases emitted from vehicular sources. The results of experimental trials showcase an impressive 99.23% accuracy in generating authentic alerts. To address the initially high project costs, the researchers successfully integrated Arduino technology, leading to a substantial reduction in expenses. This cost-effective approach significantly enhances the feasibility of implementing the proposed system to combat air pollution in urban settings.

In [10] **Rakesh Kumar Saini; Internet of Things**: A Survey on Air Pollution Monitoring The arduino makes input from the microcontroller and pass the data from the process to the software access. A set of instructions can be given to the controller through the bread board connection system. The arduino software is used as the platform to develop these kinds of hardware development which uses C++ language in it compiled with port connection through it.

III. EXISTING SYSTEM

In the existing system, the approach focuses on applying force to the sensor to detect harmful gases that may pose a threat to human health and lifestyle. This involves sending signals to the sensor and monitoring gas levels. When the detected parameter exceeds a predefined range, the system executes the code, generating analytical values. The sensor's updated values are transmitted every 30 seconds through air signals. The code execution takes place on a Raspberry Pi, a tool employed for storage and code execution. However, this method proves to be cost-intensive. Consequently, we propose a new method that utilizes gas sensors and Arduino for implementation.

IV. PROPOSED SYSTEM

Our suggested method aims to address the above described issues and offer a feature that allows data from the air pollution monitoring system to be shown in a tabular and graphical format. In addition to particle pollution detection, the system is intended to identify a variety of hazardous gases that are present in the air. Additionally, it monitors the ambient temperature and humidity. In order to inform the user that the air quality is unsafe to breathe and that they should take the appropriate steps to lessen air pollution, the device also features an alert. This simplifies the system and allows it to give the user useful information about the quality of the air in an efficient manner.

Since it is a computer-based system, it is environmentally benign.

b) Preserves the ambient air data for later usage and analysis.

b) Economical.

d) It functions with simple settings.

e) Because its primary purpose is to introduce new features, it can be created simply.

f) Secure and Safe.

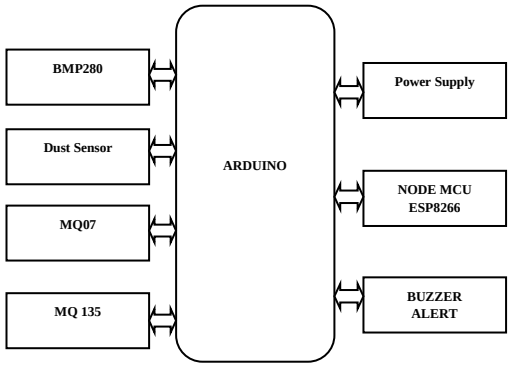

Fig 1 shows the block diagram of proposed system

The Nova PM sensor, ESP32 microcontroller, Android smart phone with the "Awaire" app loaded, and Fire store Database are the system's primary parts. The Nova PM Sensor measures the levels of PM2.5 and PM10 in µg/m3, transmitting the data in serial digital format to the ESP32 microcontroller. The microcontroller then uses Bluetooth to transmit these values to the mobile application. The mobile application receives the values, calculates the user's exposure based on a number of parameters, and then

displays the user's history and other data-driven insights. Subsequently, the data and location information are sent to the Fire store Database.

V. METHODOLOGY

The methodology embedded with hardware and software implementations:

Hardware Elements

1. V3 NodeMCU
2. Sensor Module DHT11
3. Gas Sensor Module MQ-135
4. Veroboard (KS100)
5. Joining Wires

Software Included

1. Cloud ThinkSpeaking
2. The Arduino IDE

An open-source ESP8266 development kit called NodeMCU V3 is equipped with a CH340G USBTTL Serial chip. Its firmware is based on Espressif Systems' ESP8266 Wi-Fi SoC. Even in industrial settings, CH340 is quite dependable while being less expensive. It has also been verified to be stable across all supported systems. With the Arduino IDE, coding is easy. It uses only a very little amount of current between 15 µA and 400 mA.

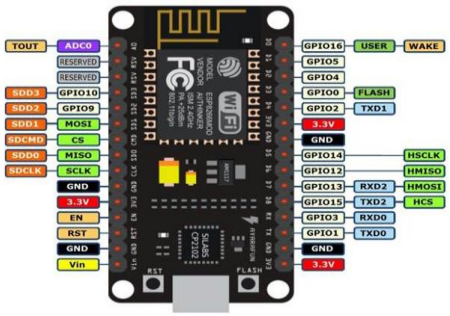

Fig. 2 displays the NodeMC3 wiring diagram.

A temperature and humidity sensor that provides digital voltage output is the DHT11. It measures the ambient air using a thermostat and a capacitive humidity sensor.

Humidity Measurement: As illustrated in Fig. 2, the humidity detecting capacitor consists of two electrodes separated by a moisture based substrate which known as dielectric functions. Temperature Measurement: A thermostat with a negative temperature coefficient—one whose resistance value drops as temperature rises—is used by the DHT11 sensor to measure temperature. Since semiconductor ceramics or polymers make up the sensor, a wide range of resistance values can be measured.

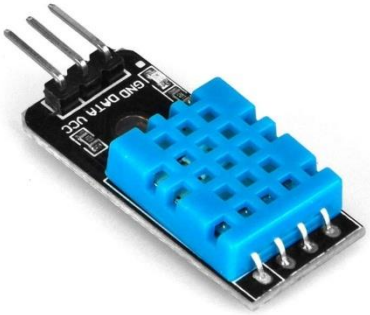

Fig 3 temperature sensor

MQ135 is made of a unique material called SnO2. In an environment free of flammable gases, it exhibits rather good conductivity, but in pure air, it rarely conducts at all. Simply construct a basic electronic circuit and translate the conductivity change into an output signal that matches.

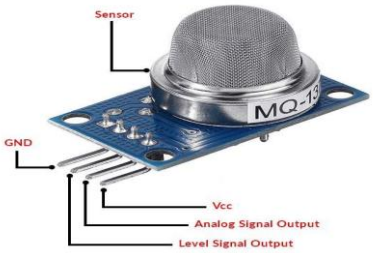

Fig 4 Gas Sensor for detection pollution system

Ammonia, sulfur, benzoene, steam, smoke, and other hazardous gases can all be detected by the MQ135 gas sensor. Applied to ammonia, aromatics, sulfur, benzene vapor, and other hazardous gases/smoke, this noxious gas detection equipment is used for family and surrounding environments. The tested concentration range is 10 to 1000 ppm.

The primary controlling role in this project is performed by Node MCU. Its programming enables it to identify sensory data from sensors and show the degree of quality on LED indicators. The DHT11 sensor module is used to measure the environment's temperature and humidity.The parts per million (ppm) of air quality can be found with the MQ-135 gas sensor module. These data are transmitted to the ThinkSpeak cloud over the internet. We also provide LED indicators that display the safety levels.

STEP 1. First, the MQ-135 gas sensor module is calibrated. The sensor has a 24-minute preheat setting. Subsequently, the hardware circuit for sensor calibration is completed and the software code is uploaded to the NodeMCU.

STEP 2: The DHT11 sensor is then programmed to preheat for ten minutes in step two.

Step 3: The final functional code is configured using the calibration result from Step 1.

Step 4: At last, the entire hardware circuit is put into practice.

VI. EXPERIMENTAL RESULT ANALYSIS

The final prototype, shown in Fig. 5, has the ability to transmit data to the server and display data on an LCD in real time. With our prototype, we collected data over seven days from surrounding environment, which we then imported into Excel to plot and compare.

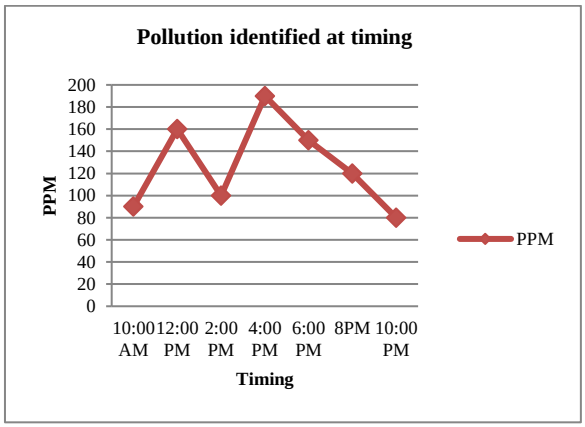

Fig 5 Pollution variation in LCD at timing range

When traveling, it also shows the pollution levels on a map. It illustrates the importance of the observed pollution levels and includes a warning about them. To make the system robust and portable, a 3D printed casing specifically designed for the sensor, microprocessor, and power supply will make the device small. The sensor can be fastened to anything the user always carries with them, like a bag.

VII. CONCLUSION AND FUTURE ENHANCEMENT

This Internet of Things project measures and shows the surrounding air's temperature and humidity in addition to the Air Quality Index (AQI). The data from the study can be utilized to determine the part-per-million air quality. The MQ135 sensor has the advantage of being able to detect hazardous gases like smoke, CO, CO2, NH4, etc., but it has the disadvantage of not being able to specifically detect the amount of carbon monoxide or carbon dioxide in the atmosphere. Several tests later, it is evident that the configuration is capable of precisely tracking the air quality in parts per million, the humidity in percentage, and the temperature in Celsius. Additionally, the led indicators assist us in determining the surrounding air quality. It would have been better if there had been gas monitors for various contaminants.

However, with time, it would become more expensive to set up and unnecessary to have an air quality analysis system. Since the project is IOT-based, uploading the data to the ThinkSpeak cloud will necessitate a steady internet connection. Thus, it is reasonable to draw the conclusion that the proposed prototype may be successfully used to control the surrounding atmosphere's temperature, humidity, and air quality.

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