IOT BASED AIR POLLUTION MONITORING AND MEASURING SYSTEM

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Abstract - ***Air pollution is a major factor in global warming and a main focus is centered on solving this problem. Security is a major focus in the proposed IoT solution. All other components of the system revolve around security. The bill of the materials and communications protocols necessary for the designing, development, and deployment of the IoT solution are part of this paper, as well asthe security challenges. The aim is to control the health threatening risks. The security implementations adhere to existing guidelines, best practices, and the standards, ensuring a reliable and robust solution. In addition, the solution is able to interpret and analyze the collected data by using measuring analytics to create pollution maps. Pollution related deaths increase every year and the leading factor for these deaths is air pollution. This paper considers pollution due to automobiles and provides a real time solution which not just monitors pollution levels. The solution is provided by a sensor based hardware module which can be placed along roads. These modules can be placed on lamp posts and they transfer information about air quality wirelessly to remote server. This information can be used for traffic control. System alerts everyone if the pollution has increased above a certain level.***

Keywords—Air pollution; sensor; IoT ;hardware; traffic control

I. INTRODUCTION

The air pollution in essential cities might reduce life expectancyby up to 20 months. However, according to a survey that wasmade by the World Health Organization (WHO) in May 2016 and updated in 2018, most big cities are facing this issue. More than 70% of civilized areas reach air pollution levels well above acceptable values [1,2]; "around seven million people get affected each year from exposure to fine particles in polluted air that lead to diseases such as stroke, heart disease and respiratory infections". The World Health Organization provides an interactive map based on estimate models, which considers fine particulate matter (PM2.5) in kiloliter. Therefore, this has become a huge problem in recent years.

In recent times the health of human beings has been directly impacted by pollution. The data obtained by measuring the Pollution in urban areas prove that pollution collisions our own lives but also the lives of the generations to come.

Therefore, it is required to be very diligent to control the harmful emissions that we release into the atmosphere.

The Internet of Things (IoT) and edge devices solution determines to monitor pollution levels, especially levels present within cities, by using various IoT devices and sensors. The stations are placed in various places. These stations periodically upload and send data to theIoT cloud. The key variation between the solution and other solutions is the designed security for the IoT gateway and communications to the IoT Clouds. The artificial intelligence (AI) and ontologies and other technologies may be used for better prediction and data analysis. Air pollution is caused by solid and liquid particles and certain gases that are suspended in the air. These particles and gases can come from car and truck exhaust, factories, dust, pollen, mold spores, volcanoes and wildfires. The solid and liquid particles suspended in our air are called aerosols.

Air pollution presents a serious threat to human health, especially in densely populated urban areas where the pollution levels continue to increase above the particular code of behavior. Statistics also show that about 30% of air pollution onan average is attributed to pollutants from automobiles. Such kind of pollution can lead to various health implications like heart and lung disorder. The purpose of air quality monitoring is not merely to collect data but to provide the information required by scientists, policy-makers and planners to enable them to make informed decisions on managing and improving the environment, in addition topresenting useful information for public end-users [6]. Our work takes into consideration this growing problem of air pollution and provides a solution by constantly monitoringair quality and controlling vehicular flow if air is polluted beyond a threshold.

India's capital Delhi is known for being one of the worst air polluted city in the world. Air pollution control was brought about by following the even odd policy of vehicles on road. Rather than blindly cutting down the number of vehicles on road, our system will ensure that vehicle traffic can be reduced or rerouted depending on the air quality.

II. RELATED WORKS

Air quality assurance is a very big concern for humanity, especially for people living in major areas. A custom extensible Air Quality Internet of Things device platform is capable of making measurements and stores all collected data in the cloud. The components used in the first version of the device cost around US$800 dollarsand are based on a Raspberry Pi3 Model B. This version was tested with six devices in the UK. Communication between the devices is achieved via an Long Range Wide Area Network (LoRa WAN).

The second version of the device—costing around US$1000 dollars—was developed next. Another approach is presented in [4], using a Raspberry Pi2 Model B board. Other perspectives on solving similar problems are presented in [5,6]. LoRa WAN is also used in a Romanian solution named Urad Monitor [7]. It equips smart city projects with sensors for various pollutants. This solution was used in Alba Iulia, with 15 sensors installed on 15 buses. This novelty of this approach is in the way the sensors work and the platform's ability to render maps using the measurements' decks and dashboards. Samples of the collected data can be accessed at [8].

Another pragmatic project is Radon Air, which was developed by the Do sitracker start-up. It determines to decreased the concentration of radon in dwellings and buildings. Another research that analyzed smart buildings is in which the authors proposed asystem that focuses on efficient energy use for data collection.

As people spend 60% of their time indoors, home air quality is also very important. The Air system is used for collecting data about ammonia, carbon monoxide, nitrogen dioxide, propane, butane, methane, hydrogen, and ethanol. The Air provides real-time alerts when the concentration of one of these gazes is excessive. The system uses an ESP8266 as a microcontroller and an MICS-6814 sensor for measurements. The collected data is stored in ThingSpeak, which allows data analysis on the time series. The micro computing unit (MCU ESP8266) is also part of another solution presented in [12].Internet for Things technology is used for the monitoring of both air and water pollution.

Another IoT project with (Supervisory Control And Data Acquisition (SCADA) technology for water quality monitoring is presented in [13]. The security of these systems is an important aspect and several studies, such as [14], focus on its implementation in data integration and air quality monitoring.

Internet for Things technology is used for the monitoring and measuring of environmental pollution. Another IoT project with (Supervisory Control And Data Acquisition (SCADA) technology for water quality monitoring is presented in . The security of these systems is an important aspect and several studies, such as [14], focus on its implementation in data integration and air quality monitoring.

The second version of the solution aims to use the IoT-NB 5G GSM (Narow Band IoT) network in a hybrid approach with Wi-Fi, SigFox, and LoRaWAN and to enhance security by using the Java Card secure element in within anindustrial IoT gateway. This uses at least an IP of 67 because of the outdoor exposure of the station.Development boards, such as Raspberry Pi 3 and Nitrogen iMX6, are suitable candidates for proof of the concepts andfast prototyping, but in real solutions they are not reliable.

III. PROPOSED ENERGY CONSERVING MODEL

The block diagram of the proposed the system is shown in Fig.1.Our proposed system acquires inputs from various sensors which detect air quality. These acquired inputs are conditioned and provided to the control unit whichprocesses these signals. The algorithm in the control unit predicts the air quality and this information are transmitted to the traffic control station. Based on this information traffic can be regulated to control air quality. Thisinformation can also be viewed using a mobile application. This additional feature allows users to follow less polluted routes thereby indirectly bringing down pollution in highly polluted areas.

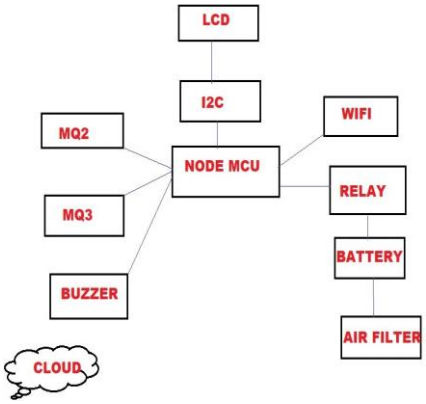

FIG.1 : BLOCK DIAGRAM

To design a smart air pollution monitoring system that can monitor, analyze and predict the quality of air based on the sensors. The proposed solution of our system which monitoring as well as measures the pollution by using sensors, battery, relay switch, LCD and air filters. Our system reduces the environmental pollution. To prevent, control and abate pollution of Automobiles and protect the environment from any degradation by effective monitoring and implementation of Air pollution. Purposefulness of areas polluted at acertain moment in time parks, cities or any other public area. In most polluted areas, the motive is to avoid pollution. Inflammatory specific public actions, such as partial road closures, in order to decrease the current pollution level or the triggering of alarms if excessive measurements have been recorded.

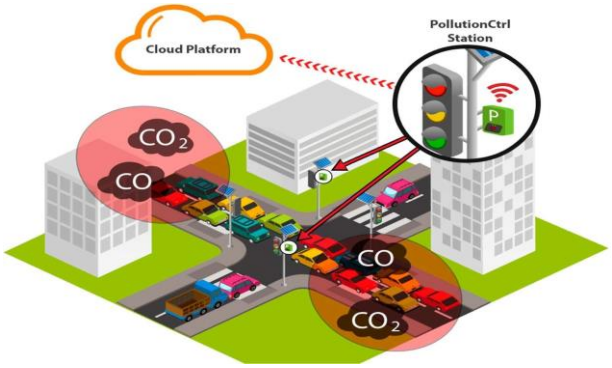

FIG.2 Internet of Things monitoring solution for pollution—generic view.

The proposed system was developed using the NODE MCU- Node MCU is an open source platform based on ESP8266 which can connect objects and let data transfer using the Wi-Fi protocol. In addition, by providing some of the most important features of microcontrollers such as GPIO, PWM, ADC, it can solve many of the project's needs alone.

The environmental setup for the developed system is shown in Fig 6. The work was prototyped and we have we considered sensors, MQ-2 It can detect LPG, Smoke, Alcohol, Hydrogen, Methane and Carbon Monoxide concentrations anywhere from 200 to 100000ppm. MQ-3- Gas Sensor (MQ3) module is useful for gas leakage detection (in home and industry). It is opt for detecting Alcohol, Benzine, CH4, Hexane, LPG, CO. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. Relays are the switches which aim at closing and opening the circuits electronically as well as electromechanically. It controls the opening and closing of the circuit contacts of an electronic circuit. When the relay contact is open (NO), the relay isn't energize with the open contact. The role of a battery (or cell) in an electric circuit is to supply energy to the circuit by doing work upon the charge to move it from the low energy terminal to the high energy terminal.

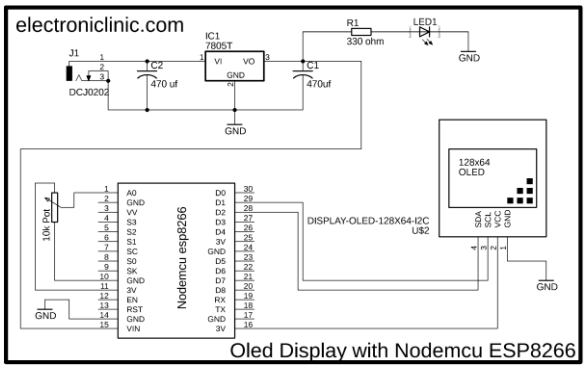

FIG.3 : SYSTEMATIC DESIGN OF NODE MCU

Liquid-crystal display (LCD) is a popular type of technology used in electronic displays. As the name suggests, it's characterized by the use of liquid-filled crystals to produce images. Because liquid crystals have light-modulating properties, LCDs are particularly effective for this purpose. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates a display 16 characters per line in 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols.

Control Pins-This pin is known as a register select pin. It assist to determine the data register. The signals can decide whether it is going to read from LCD or write on it. It enables the pin to help to transfer the instruction from the data pins and another command pin to the LCD.

IoT enabled **air purifier** using ionization is a technology that can help everyone to lead a happy and healthy life with lost cost compared to all other available air purifiers like air purifiers with HEPA(high efficiency particulate air)filters and electrostatic air purifiers. Filters are used to remove foreign particles like dirt, dust and grit or filters are used to remove dust and particles out of the air. It may also remove odors and gaseous pollutants. It acts as a silencer for the carburationsystem. Air purifiers are the best way to clean your air indoors,which can be polluted and full of triggering particles like pollen and dust. They also help maintain a healthy environment by removing pet dander, mold spores, ragweed and and more.

A **buzzer** is an electrical device that is used to make a buzzing sound for example, to attract someone's attention. The buzzer is a device that can convert audio signals into sound signals. It is widely used in computers, printers, alarms and other electronic products as sound devices. It is mainly used to indicate the level of Air pollution when the Air quality goes down and when pollution increases.

The output from the signal conditioning circuit is then provided as input to an analog to digital converter of 10 bit resolution. PIC16F877a is a PIC Microcontroller and is normally used in Embedded Projects like Home Automation System, Bank Security System etc.

The inputs are given to an air quality monitor algorithm which gets input values and compares them with threshold values.

The air quality information is then transmitted via a WiFi transceiver-ESP 8266 to a remote server from where this information can be accessed by the traffic control.

This information can also be accessed through a mobile application. The designed system not only sends a message but also displays the status of the parameters of air quality through a LCD display.

IV. RESULTS AND DISCUSSION

The performance of the proposed work were analyzed. To analyze this work, two methods from related existing works were also simulated. The related works were also simulated under the same condition with this work. The simulation clearly showed that the performance of the proposed work outperforms the existing works in terms of energy consumption.

The proposed system was prototyped and tested. The system was validated using various test cases

Test case-1: Acquiring inputs from sensor.

Test case-2: Processing data.

Test case-3: Wireless Transmission

Test case-4: Display of gases present in CLCD.

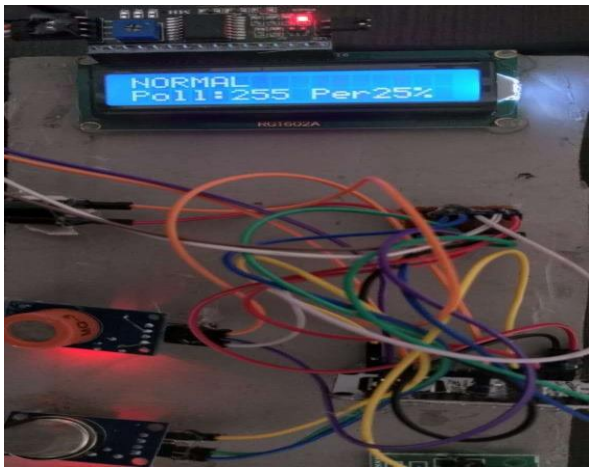

FIG 4 : Test case-1: Acquiring inputs from sensor

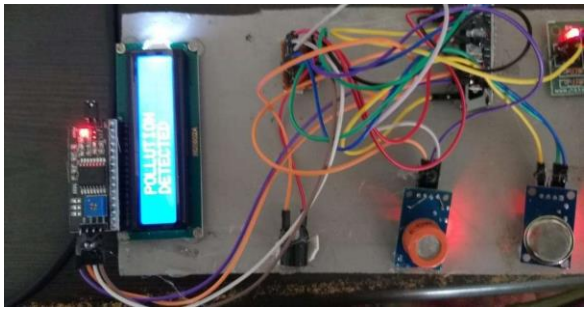

FIG 5 : Test case-4: Display of gases present in LCD

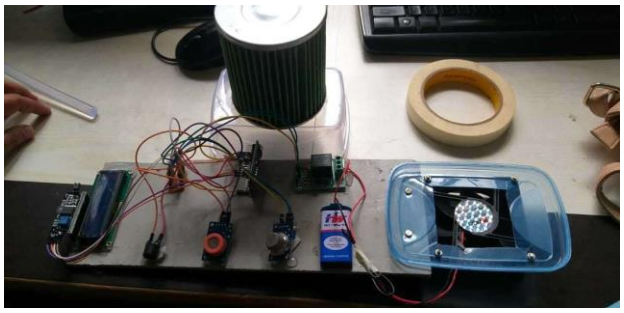

FIG.6 The environmental setup for the developed system

The Figure.6 clearly shows that the proposed work coincides.

V. CONCLUSION

The proposed system was designed and monitored and could control the various poisonous gases and filter them through filters. Although there are a huge number of existing systems, the proposed system provides a unique feature by transmitting calculated information for traffic control purposes if air quality is detrimental. The additional benefit of the proposed system is the mobile application which will help the common.

Air monitoring systems based on the advancement of IoT framework has the rapid development and becoming an emerging research going on. Majority of the countries used various computational tools and techniques have established with their particular national prediction and monitoring models. The proposed system was designed and tested. The proposed system measures the air quality of a particular area with the help of the hardware module fixed at certain locations like lamp posts. The proposed system collected real time pollution statistics using various sensors which monitored percentage of gases like ammonia, oxygen and carbon monoxide. Using these inputs the algorithm predicted the air quality. Although there are a huge number of existing systems, the proposed system provides a unique feature by transmitting calculatedinformation for traffic control purposes if air quality is detrimental. The additional benefit of the proposed system is people can understand and be aware of the pollution status of localities. This awareness can also lead to people making a contribution directly to reduce pollution levels. is the mobile application which will help the common.

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