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AN EARLY WARNING AND ACCIDENT AVOIDANCE SYSTEM BY SMOG POLLUTION USING IOT

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Abstract: *Air pollution and smog events are issues that are experienced in many large cities worldwide. Vehicle emissions are the largest contributor to these problems. The system presented in this paper aims to provide air quality and smog information for possible regulation of hybrid vehicle emissions. The issue of environmental pollution and climate change has become an international concern due to their affects to the physical and biological entities of the environment. In this paper, the main objective is to find the pollutants in nature with the help of the Internet of Things (IoT). To reduce the emissions that contribute to smog during times when smog events are either possible or occurring. The system takes in ambient Environmental data through an array of sensors that are sensitive to various pollutants and that are associated with the formation and chemistry of smog. It then makes a decision as to whether smog event is possible or if the air quality is poor according to the standards. This calculation allows a user to observe the ambient air quality in real time and warns them if there is a possible smog event. At winter climates the polluted air and the mist will form the smog, it will reduce the turbidity level of the surroundings, this leads to the accident of vehicles, and breathing issues of living beings. An IOT based control system will introduce the early warning and control technique for the SMOG.*

Keywords: Air Pollution, Smog, Climate Change, Air Quality, Internet of Things

I INTRODUCTION

In our lives, dust is everywhere. For example, soil and rocks will be split into many fine particles after weathering. In addition, dust is a by-product of industrial production and transportation development. The term smog originates from when the city experienced extended periods of smoke and fog, hence the name smog. There are numerous sources that contribute to smog; however car emissions constitute a substantial contributor. Cars emit particulate matter, CO, CO2, NOx, and hydrocarbons, each of which add to the degradation of the overall air quality. There are two types of smog, photochemical and combustion, each of which are harmful to life on Earth.

This type of smog is formed when there is particulate matter in the air, such as soot or ash, which absorbs water vapour and SO2. This will create a very dense fog that can linger for a few days. This type of smog can also be formed from other compounds, such as H2SO4, however the general consensus is that SO2 is the leading compound for this type of smog. The driving force for this reaction is water vapour, without it being humid / foggy; H2SO4 will break down into an aerosol. Water vapour is also needed for the SO2 to be absorbed into the soot. Photochemical smog is typically associated with large hot cities such as Los Angeles. These types of smog are more prevalent in today's societies. There is a constant cycle in the atmosphere that tends to keep the air relatively clean, however this cycle can become disrupted, which can create smog.

As cars release pollutants into the air, one of which, NO2, is a pivotal precursor for photochemical smog. Typically, when NO2 is released into the environment, it will be photolysis by the sunlight to produce NO and an O radical. The O radical then reacts with O2 molecules in the surrounding air to produce O3. Even under circumstances when smog wouldn't normally be produced, this O3 molecule reacts with NO to form O2 and NO2, which will result in a temporary increase of tropospheric O3.

The Environmental Protection Agency (EPA) uses a system for determining the overall air quality of an area based on the negative impacts experienced by humans. The EPA has made the system as simple as possible by reporting the results as a value and as a colour to allow people to easily distinguish between good and bad air quality.

The system is used to warn citizens to take precautions while going outside during times of high pollution. This paper presents a system that can detect or perhaps predict when there is a possible smog event, calculates the air quality index, and reports a more accurate representation of the overall air quality.

2 Related Study of Air Contamination

Air quality is in the news globally, whether the context is regulatory breaches, poor visibility, traffic congestion or health impacts. Air pollution levels in many cities exceed legal and World Health Organization (WHO) limits for particulate matter and gaseous pollutants which can be found in concentrations that are hazardous to health. Poor air quality is causing a public health problem, since breathing polluted air increases the risk of debilitating and deadly diseases such as lung cancer, stroke, heart disease and chronic bronchitis. Air pollution is now the world's fourth-leading fatal health risk, reported as causing one in ten deaths in 201311 term predictions for air quality that may in future be used for interventions.

In addition the IoT based air quality sensors allow improved monitoring of air quality, at a more granular level, and in near real time (typically reported every minute). The new air quality monitoring solutions will emerge, their development stimulated by the continued improvements to the capabilities of IoT sensors/devices, the wide availability of Mobile IoT technologies and the increased focus by governments on air quality. We encourage mobile operators to explore these new revenue opportunities and to consider the additional value of including network derived mobility data (which is a unique network operator capability) as part of their offering in Air Quality Monitoring Using IoT.

Feng Yanjiao, Yang Bifeng Lan Huiyan, Lan Huiyan on Design of Air Quality Detector Based on STM32 explained that The haze contains a variety of fine particles that are harmful to the human body, which can have a significant negative impact on human health. At the same time,the haze weather will affect traffic safety and easily cause traffic jams. In serious cases, it will cause traffic accidents due to blurred vision of drivers. So need to pay great attention to air quality. Therefore, this article proposes an air quality detector. This design uses the smallest single-chip microcomputer system with STMicroelectronics.

So in this paper a solution for monitoring the air pollution levels i.e., any parameter value crossing its threshold value ranges, for example O2 levels in air in a particular area exceeding the normal levels etc., in the environment using wireless embedded computing system is proposed in this paper. The solution also provides an intelligent remote monitoring for a particular area of interest. In this paper also describe present time results of sensed or collected data with respect to the ordinary as well as specified ranges of particular parameters. The embedded system enables the user to remotely access the various parameters and store the data in cloud and this system is an integration of sensor devices with wireless communication. The quality of air is important for the survival of living beings. It is necessary to monitor air quality.

3 Existing System model

In today's world many pollution monitoring systems are designed by considering different environmental parameters. Existing system model is presented in figure.1 uses Zigbee based wireless sensor networks to monitor physical and environmental conditions with thousands of application in different fields. The sensor nodes directly communicated with the moving nodes deployed on the object of interest which avoided the use of complex routing algorithm but local computations are very minimal. RFID is a means of storing and retrieving data through electromagnetic transmission to an RF compatible integrated circuit.

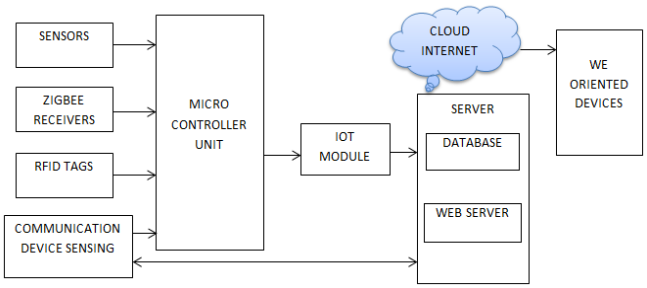

Fig.-1. Existing System Block Diagram

It is basically used to track and label items in supermarkets and manufactories. There are two main components of RFID systems: tags and

readers. A tag has an unique identification (ID) number and a memory which is used to store additional data such as manufacturer, product type, and environmental factors such as temperature, humidity, etc. Through Wireless Communication the reader is capable to write and/or read data to tags., In need of identification or tracking, tags are embedded or attached into objects in a typical RFID application. RFID tags can be classified into three major categories by their power source: active tags, passive tags, and semi passive (semi-active) tags are embedded or attached into objects in a typical RFID application.

Mobile phones or smart phones those are cap abled and in built with sensors are applicable for impact on social including how technology of mobile has to be used for to protect environmental, sensing and to influence just-in-time information to create movements and actions eco-friendly. Mobile phone sensors were deployed and used on urban areas for monitoring and it was categorized into two major classes, participatory sensing where user is directly involved and opportunistic sensing where user is not involved, but its limitation includes power and static information processing or mobility restrictions.

A Wireless Sensor Network inbuilt of many wireless sensors those are inexpensive, which are able to collect, store, process an environmental information, and to communicate with nodes those are neighbours to each other. Previously, sensors are connected by wire lines. The access method of WSN gateway node is convenient because data can be received from a WSN via the gateway at any time and any place. In charge of node authentication, message buffering, the gateway works as the network coordinator where you can collect, process, analyse, and present your measurement data. Wireless sensor network management model consists of end device, router, gateway node and management monitoring centre.

To collect wireless sensor network data, and to forward them to parent node, hence end device is trustworthy then data are forward to gateway node from parent node directly or with the help of router. Gateway node extracts data after getting data from wireless sensor network, then analyses and packaged them into Ethernet format data, forward them to the server. A server is an occurrence of a computer program that is used to accept then reply to another program request; called as a client. So we could say that to run the server software any device could be considered a server. To manage network resources Servers are used. In the servers, the services or information are provided through the Internet those are connected through LAN and made available for users via smart phones, web browser or other web browser devices to make the system more intelligent, adaptable and efficient.

PROBLEM IDENTIFICATION:

- Communication range is less.
- Need of personal computer for monitoring.
- Control unit is required for high area space.
- Data storage requires external device.
- Design is more complicated.

4 PROPOSED SYSTEM MODEL:

i) AIR POLLUTION AND SMOG EVENT DETECTION:

To detect a smog event, the system will look for the key components that are associated with smog formation. For photochemical smog, the system detects the cycle that O2 goes through during the formation of ozone. If the system notices a large flux in O2, while also noticing a rise in ozone, then there is a high possibility that there could be a smog event in the area. Therefore, if the system notices a flux in O2 without the presence of sunlight, then it will conclude that it is simply in an area with high levels of pollution. For combustion smog, the system will simply monitor the ambient air for O2, particulate matter, and humidity. There is no concise data on the specific concentrations of these pollutants that are present during a combustion smog event.

Therefore, this system will make a prediction as to whether there is a smog event based on the EPA's Air Quality Index (AQI) standards and other attributes commonly associated with it. If the AQI value for both particulate matter and O2 reach the unhealthy category, then the system will indicate that there is a smog event if it is humid enough. The driving force to produce combustion smog is the presence of humidity. Fog tends to form when the relative humidity of an area approaches or even exceeds 100%. The report evaluates the relationship between relative humidity and turbidity, temperature and the transmittance that is

measured across the fog chamber. These results support the notion that during fog events, the relative humidity is around 100%.

ii) MQTT protocol:

Research monitoring of learning environments using WSN has been developed to monitor environmental conditions [4, 5]. In the study, the sensor nodes consisted of microcontroller, wifi modules, and sensors. The physical quantities of the monitored environment are light, temperature, humidity, and noise. Each magnitude is measured using sensors mounted on the sensor node. Monitoring results are sent to the web server via the internet network. Research on air quality monitoring using the MQTT protocol has been done using a Node MCU processor coupled with two O2 gas sensors and a temperature sensor and turbidity sensor [6].

MQTT has also been applied in green house monitoring, driving and fuel consumption; smart environmental monitoring, and monitoring of hazardous gases. IoT technology with MQTT-WSN architecture is applied to monitor air and sound pollution. In this study the sensor nodes use Arduino and PIC as Microcontroller and communicate using Node MCU modules which is connected to the Controller via WSN. The results of monitoring are processed and displayed on a web-based interface application.

iii) HARDWARE SETUP ARRANGEMENT:

In the hardware design of the entire system, the following points need to be considered: the design of the minimum system, the choice of the LCD screen, the choice of the communication transmission method, and the choice of each sensor. In the selection and design of each module, it is necessary to consider the coordination and cooperation between the various modules. Only by coordinating the work of each module can the entire air quality detection system achieve a more ideal working effect. O2 sensor and temperature and turbidity sensor calculate and process the collected data and send it to a single-chip PIC microcontroller as the core. The LCD screen displays the dust concentration in the air and the temperature and turbidity values.

At the same time, the measured data is transmitted via IOT wireless The transmission module transfers to the host computer, displays the air quality on the host computer software, and draws a line chart. If the dust concentration in the air exceeds the set value, the sound and light alarm will give an alarm. At the same time, the device will issue a early warning for dust exceeding the standard. At the same time, the data will be stored in the database in the form of excel to facilitate data query.

This paper is to monitor SMOG on roads and track location which causes pollution over a specified limit. An embedded system is a controller with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. Wireless sensors networks send the details to the used over Internet through ESP8266 module. IOT will overcome the communication issues over the long range. GSM sim800 module used to send the location information to the monitoring section.

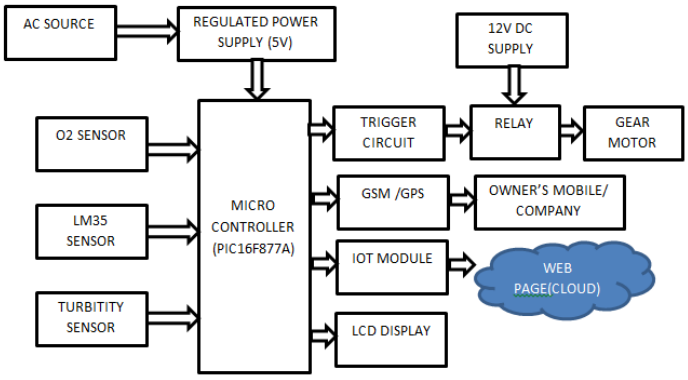

Fig.-2. Proposed system block diagram

A. Wireless sensor node

A wireless sensor network is associate infrastructure consisting of computing, sensing and communication parts, Which permits the administrator to watch & control of the desired parameters within the network. Typical application of WSN includes knowledge assortment, monitoring, surveillance work & medical telemedicine. It's conjointly utilized in irrigation system, Greenhouses for observation & controlling parameters like water flow, temp, humidity, moisture, etc. Sensors are hardware devices that manufacture measurable response to a amendment in an exceedingly healthiness of pollution. The associate analog signal send by the sensors is digitized by an analog to digital device & send to

controller for any Processing. There are differing kinds of detectors from that we are able to choose the acceptable} & appropriate sensor Relying On the applying.
Sensor 1 (O2 detector):- The O2 sensor senses the gas and communicates the info with microcontroller.
Sensor 2 (Turbidity sensor):- The chemical element sensors sense the gas and communicate the info with microcontroller.
Sensor 3 (temp detector):- The worker sensor senses the temperature and communicates the info with microcontroller.

B. Microcontroller unit

PIC has only 35 single word instructions. All are single cycle instructions except for program branches, which uses two-cycle. The Operating speed of PIC in DC is 20 MHz and clock input in DC is 200 ns instruction cycle. The PIC has 8K x 14 words of flash Program Memory, 368 x 8 bytes of Data Memory (RAM).

i) PERIPHERAL FEATURES

Timer0, Timer1, Timer2: 8-bit timer/counter with 8-bit period register, prescaler and postscaler. It has a Capture, Compare, PWM (CCP) module. Capture is of 16-bit and it has a maximum resolution of 12.5 ns. Compare is of 16-bit and it has a maximum resolution of 200ns.Pulse Width Modulation has a maximum resolution of 10-bit.8-bit,

- 8 channel analog-to-digital converter with 10 bit each.
- It has a Synchronous Serial Port (SSP) with SPI (Master/Slave) and I2C, USART with 9 bit detection. It also has a Brown-out detection circuitry for Brown-out Reset (BOR).

ii) ANALOG-TO-DIGITAL CONVERTER (A/D) MODULE

The Analog - to-Digital (A/D) converter module has eight inputs for 40 pin devices. The A/D allows conversion of an analog input signal to a corresponding 10-bit digital number. A/D converter has a unique feature of being able to operate while the device is in SLEEP mode. To operate in SLEEP, the A/D conversion clock must be derived from the A/D's internal RC oscillator. The ADCON0 register controls the operation of the A/D module. The ADCON1 register configures the functions of the port pins. The port pins can be configured as analog inputs. Due to following advantages PIC microcontrollers are used and the performance of the PIC microcontroller is very fast because of using RISC architecture. When comparing to other microcontrollers, power consumption is very less and programming is also very easy. Interfacing of an analog device is easy without any extra circuitry

C. Global Positioning System

GPS receivers are used for navigating, positioning, surveying, locating and determinant the time and are used each By non-public people and corporations. Throughout the event of the GPS system:
(a) it's to supply users with the potential of determinant time, speed and position whether or not in motion or at rest.
(b) It ought to have a continual, global, three dimensional positioning capabilities with a high degree of accuracy, Irrespective of the weather. Global Positioning System is important customary used for
Navigation, chase and placement aware knowledge work. Board Can be interfaced with a microcontroller through UART. Knowledge like latitude, meridian of the realm wherever vehicle located is received. Board options connection compatible with antennas. It will operate 3.3V power provide solely.

D. Digital display show

Liquid Crystal Displays are the simplest man and machine interface giving spectacular visual data, displaying Icons, Symbols, Numerical, Alphabets and Characters. We've used LM016 16x2 digital display. This system consists of Mobile Data-Acquisition Unit (Mobile-DAQ) and stuck web Enabled Pollution observation Server (Pollution server).Mobile-DAQ consists of a 32-bit single- chip microcontroller integrated with a detector array using analog ports. The Mobile-DAQ is connected to a IOT ESP 8266 Midyke and portable victimization RS-232 interface.

AQI as Reported by EPA		Ozone (ppm)		Particulate Matter (µg/m3)		CO (ppm)
		8-hour	1-hour	PM2.5	PM10	8-hour
Good	(0-50)	0-0.054	-	0-12	0-54	0-4.4
Moderate	(51-100)	0.055-0.07	-	12.1-35.4	55-154	4.5-9.4
Unhealthy for Sensitive Groups	(101-150)	0.071-0.085	0.125-0.164	35.5-55.4	155-254	9.5-12.4
Unhealthy	(151-200)	0.086-0.105	0.165-0.204	55.5-150.4	255-354	12.5-15.4
Very unhealthy	(201-300)	0.106-0.2	0.205-0.404	150.5-250.4	355-424	15.5-30.4
Hazardous	(301-500)	-	0.405-0.604	250.5-500.4	425-604	30.5-50.4
AQI Expected Data of Proposed system		CH_4 (ppm)	Toluene (ppm)	Ammonia (ppm)	UV Intensity (V)	General VOC (Ethanol ppm)
Good	(up to 100)	0-500	0-4	0-16	0-1	0-200
Moderate	(101-200)	501-1000	5-9	17-24	1.1-4	201-300
Unhealthy for Sensitive Groups	(201-300)	1001-2000	10-15	25-34	4.1-7	301-400
Unhealthy	(301-400)	2001-15000	16-20	35-100	7.1-10	401-500
Very unhealthy	(401-500)	15001-499999	21-149	101-299	10.1-13	501-600
Hazardous	(Greater than 501)	≥ 5000000	≥ 150	≥ 300	≥ 13.1	≥ 601

Table 1: AQI comparison of Proposed System

For the detection of combustion smog, the system monitors both particulate matter 2.5 and 10 alongside O2 levels. If the particulate matter reaches the unhealthy AQI category, while the SO2 concentrations are also in the unhealthy for sensitive people AQI category, then the system will indicate that there could be a smog event. If the previous criterion is met and there is ample humidity in the air, approaching or exceeding 95%, then the system will indicate that there is a smog event. Because SO2 is so unhealthy, it is to be expected that their concentration levels should remain relatively low; therefore, if the system detects a rise in this concentration, then the system will also indicate that there could be a smog event. Most of the sensor circuits created were relatively simple, only requiring finding an optimal limiting resistor for a voltage divider. This allowed the system to include a large number of sensors in the array.

The different subsections where the design and created of the prototype together with the algorithms implementation and its cloud connection are explained. The design of the device had to accomplish some requirements for achieving the final goals Proposed. Some statements have to be achieved in order to follow the low-cost, but reliable, final Device. This prototype were implemented with following benefits

- The device has to use low-cost components to create affordable sensor networks of several devices with a relation cost-quality.
- The device has to have reliability for long-term measurements.
- The device should have capability to be connected to the cloud for remote updates of the software and for sharing results.
- The quality of the measurements has to be enough for advanced audio parameters' calculation.
- The device has to have enough computing power to do on-board calculations.
- The device has to be able to connect to the Peripherals needed for the purposes of the project.
- The device has to be able to interpret C programming language.
- The sound flow acquisition has to have the less noise inputs as possible, for avoiding extra Filtering steps.
- The final device has to be protected against outdoor conditions using a protective housing.
- The device needs to have different connectivity options (i.e. Wi-Fi or Ethernet).
- The distance from the nodes to the power source should be a maximum of WIFI range.

E. RESULTS AND DISCUSSION

Gas sensing could provide valuable data to diverse applications, using the IoT paradigm, offering important data for decisions taken by smart devices. They can provide better experiences to users. This project provides information to the public about projected levels of environment pollution, with reduction of outside action and avoidance of car driving and other petrol vehicles in such highly polluted areas. A remote survey is conducted to accumulate the data for future reference. Installing reference air quality monitoring systems based on gas analyser technology is one way to measure road, motorway and highway emissions. But their cost and size limits the number of monitoring locations. Location and sensor data verified by GPRS technology and thing speak open-source website from anywhere.

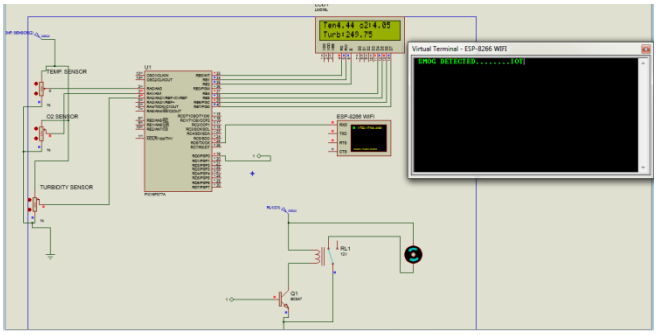

Fig.-3. Simulation verification of Proposed System

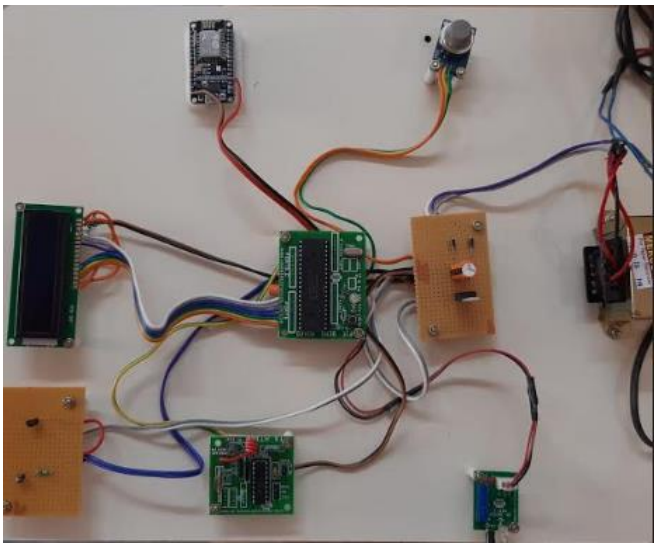

Fig.-4. Hardware Prototype Model.

V CONCLUSION

The Proposed architecture is implemented and optimized of our own air quality sensing system, which provides real-time and fine-grained air quality map of the monitored area. The proposed system identified the problem of power control and location selection of the air quality sensing system in a smart city. In addition, the development of one unique device, capable of collecting data from numerous gases information's are guided to avoid road accidents .Furthermore, it is necessary to make these technologies more affordable; reducing the costs of production of these devices is fundamental to make the benefits of these sensors.

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