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Air and Sound Pollution Monitoring System Using IOT

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Abstract- The growing air and sound pollution is one of the serious issues these days. As the pollution is increasing it is giving rise to number of diseases. So, it has became necessity to control the pollution to ensure healthy living and better future. The Air and Sound Pollution Monitoring device can be accessed by the each and every people curious about the pollution level. The device can be installed through a mobile application which will show the the pollution level. This device is can also detect the fire in its area and update the same to the fire authorities as they can take necessary actions on situation and can control it to reduce loss. This system works on the methods of IOT which is a rising technology based on the fusion of electronics and computer science. The concept of IOT helps to access data from remote locations and save it in database so that we don't need to actually be present in that area.

Keywords: **air pollution, sound pollution, IOT, sensors, monitoring system**.

Introduction

Day to day we are going through the area we came across latest technology. Back in time checking the pollution in a particular area was a very tedious task which was not very efficient also. With the increasing pollution and advancing technology various new methods were introduced to keep an eye on the rapid increase in pollution more efficiently. Internet of things is one of the latest works that has been done in this path. The increment in use of internet and the interaction of human with machine gave rise to IOT. It allows exchange of information among various devices like fridge, washing machine, automobiles, watches etc. This exchange of information takes place with the help numerous sensors. The account for the success of IOT is its efficiency and makes it a feasible technology at low cost. Air and sound pollution are two main constituents that have the most adverse effect on humans as well as the entire earth. Therefore it is very important to check and control it. Traditional methods involves manual work in which data loggers used to visit the site to collect the data, analyze it and perform comparisons to provide the output which was very lengthy and time consuming besides being inefficient. The monitoring system uses of sensors that detects the sound pollution concentration and level of harmful gases like Carbon dioxide and Sulphur dioxide which pollutes the air. Comparitively using previous stored data in database and output is stored on cloud to make it accessible from remote to everyone. This paper involves system's description that gives its output with the help of an android application which the user can access in their mobile phones and access it whenever they need.. This device is a useful asset to save precious lives of people and property about it. After that the people are made to clear the area and taken to a safe place.

Related Work

Arushi Singh et al. have proposed a system which uses air and sound sensors to monitor the data constantly and then transmit the data. A raspberry pi module interacts with the sensors and processes the data thereby transmitting it to the application. [1]

Dr. A Sumithra et al. have proposed the concept of a smart city. Technology and communication is the basis of this smart city. Various sensors and modules have also been used to monitor the various environmental parameters. This system uses air and sound sensors to monitor the data and then upload the data on the cloud server as digital data. The cloud storage managers analyze the data and notify accordingly. [2]

SRM. ArthiShri et al. have proposed the idea of monitoring the parameters using a PIC microcontroller which senses the atmosphere signals. Gas sensors are used to measure the pollution level. This data is uploaded on the internet and can also be viewed through an app. [3]

Seung Ho Kim et al. have designed a monitoring system that uses an environmental parameter analyzer and sends the results in a server through a LTE communication network. The resulted data was compared with the data obtained by the National Ambient air quality Monitoring Information System (NAMIS). [4]

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Existing System

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. 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.. 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. A server is an occurrence of a computer program that is used to accept then reply to another program request; called as a client.. 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.

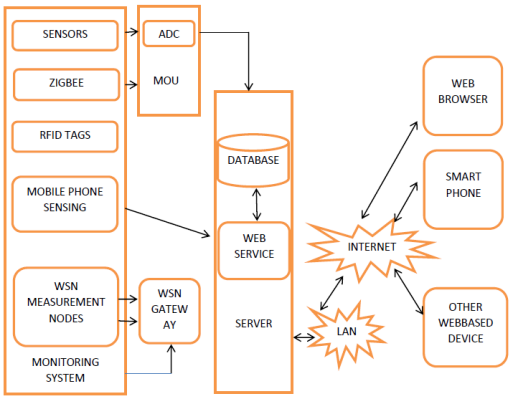

Fig.1: Existing System Model

Proposed system

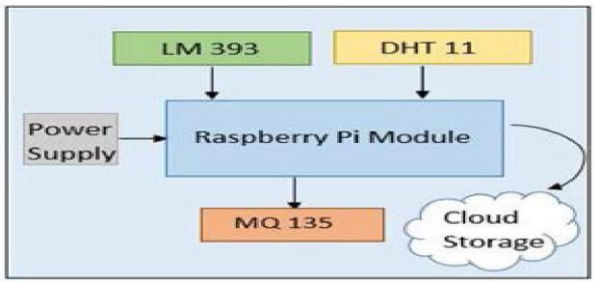

Fig. 2 : Block Diagram of the System

Articture and Modules Used

A. Xmega 2560

XMEGA 2560 is an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for it. The Xmega 2560 Uno is a variety of Xmega 2560 board based on the Xmega 2560. It has fourteen digital input/output pins (of that half dozen are often used as PWM outputs), half-dozen analog inputs, a sixteen megacycle per second megacycle ceramic resonator, a USB affiliation, an influence jack, an associate ICSP header, and a push button. The Xmega 2560 programming language is an implementation of wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment.

B. Regulator

Voltage regulator IC's are the IC's that are used to regulate voltage. IC 7805 is a 5V Voltage Regulator that push down the voltage output to 5V and takes out 5V regulated power supply.

C. LM393 Sound Sensor I

It has two independent voltage comparators that are made to operate from a one power supply over a large range of voltages. Operation from two supplies also is possible if the difference between the two supplies varies in 2 V to 36 V, and VCC is at least1.5 V more positive.

Fig.3: LM393 Sound Sensor

D. MQ135 Gas Sensor

In this project, to monitor the air pollution and to determine the air quality index, a gas sensor, MQ135 is used. MQ135, gas sensor operates at 5V voltage and 40 mA current. It efficiently detects the Nh3, NOx, smoke and CO2 level in air. This sensor is chosen for its wide detecting scope, fast response, high sensitivity, stable and long life and lastly, a simple drive circuit.

Fig.4: MQ135 Gas Sensor

E. DHT11 Temperature and Humidity Sensor

DHT11 is a humidity and temperature sensor. It can be used to monitor the temperature and humidity levels in a region. It can be interfaced with a Raspberry Pi module and can give immediate results. In this project, we are using this sensor to monitor the varying humidity and temperature levels.

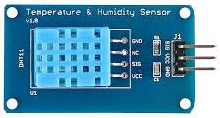

Fig.5: DHT11 Temperature and Humidity Sensor

F. Raspberry Pi Model 3B

In this project we are using a Raspberry Pi 3B module. It is an ARM based credit card sized SBC (Single Board Computer) created by Raspberry Pi Foundation. A Wi-Fi and Bluetooth module is already present in the Raspberry Pi 3B. Using this module, we can send the acquired converted digital counterparts of the parameters, over the internet, to a Cloud based storage area. The saved data is not only used for monitoring purposes, but for analyzing the information acquired, on a periodical basis.

Fig.6: Raspberry Pi Model 3B

G. GPRS Module

It stands for Global Packet Radio Service. It is used to establish a communication channel between the computer and GPRS/GSM system. It is an advanced version of the GSM module which enables high data transmission rate. It requires a SIM (Subscriber Identity Module) to activate a connection with the device. In this project we add the GPRS system to the Raspberry Pi module to connect to the internet using mobile data.

Fig.7: GPRS Module

H. BUZZER

A buzzer is a mechanical, electromechanical, electro-acoustic or piezoelectric audio gesture device. The **piezo buzzer** produces sound depending upon on reverse of the piezoelectric effect. The variants of pressure variation or strain by the application of electric potential across a piezoelectric material is the concealed principle.

Fig.8: Buzzer

I. WIFI MODULE

The Wi-Fi Module is a self inbuild SOC with integrated TCP/IP protocol stack. The WIFI is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each WIFI module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Xmega 2560 device and get Wi-Fi-ability. The WIFI module is an extremely cost effective board with a huge, and ever growing, community. It is capable of hosting an application or offloading all Wi-Fi networking functions. It is already programmed with an AT command to set firmware. The ESP8266 module has a powerful enough on- board processing and storage capability this allows it to be integrated with the sensors. It has a self-calibrated RF permits it to work under all operating conditions.

Working of the project

In view of the day to day struggle of a household the monitoring of real time parameters is highly useful for the sustenance for well informed standard of living. The parameters we are dealing with are various gases, dust, room temperatures and humidity present required for an good environmental living. The respective sensors are being utilized for acquisition of the required data to be monitored as shown in Figures in next. DHT11 sensor has been used to monitor the room temperature and pressure. The sensors are soldered onto a printed circuit board with a 3.3Volts regulator, I2C level shifter and pull-up resistors on the I2C pins. It is a 4 pins sensor of which 2 pins uses I2C protocol (SCL and SDA) which are connected to the respective I2C protocol supported pins on the Xmega 2560. It is based on the piezo resistive technology. The parameters are then send to the microcontroller MQ-2 sensor is a gas sensor which can detect the presence of combustible gases such as ibutane, LPG, hydrogen & methane. In this project, it is used mainly for detecting household LPG. The ionized constituents are detected by the sensing element, it gives output in the form of current. The concentration of the gas detected is then send to the Xmega 2560. It has both the analog and the digital output but here we use the analog output which is connected to the analog pin of the microcontroller. The sensor provides fully calibrated digital outputs for the measurements of the parameters. It works at a voltage of +5v and produces the digital output connected to any of the digital pin. The MQ-135 gas sensor senses the gases like CO2, ammonia nitrogen,

oxygen, alcohols, aromatic compounds, sulfide and smoke. In this module it has inbuilt set of Attention Commands which are used to configure the module. Firstly we flash the ESP8266 module using the software then using the Attention Commands it is set in the Wi-Fi mode and then it is connected to a mobile hotspot or a Wi-Fi, which finally connects our microcontroller to the WiFi. The whole processing required is done by the processor in it. Starting with this project, first of all we flash the memory of the Wi-Fi module (ESP8266) to avoid any garbage values in our readings, then moving on to the later step it uses attention commands to set the module in the Wi-Fi mode and search for the available access points and then connect to any of them. In this the components used in the project are represented in the form of blocks and shows how we carried out our work. First of all using all the 4 types of sensors we collected data then this data is latched in the microcontroller, then after performing all the basic requirements required by the Wi-Fi module, we connect our microcontroller to the access point and then finally we upload the data to the channel.

Results

Air Quality Index

It is a value that is communicated by the government to the public as to how polluted the environment is or will become. As the AQI increases, various health hazards come up. The AQI can be computed by calculating the average pollutant concentration over a specified period. The formula for calculating AQI is,

$$I=(I_{high}-I_{low}/C_{high}-C_{low}) *(C- C_{low}) + I_{low}$$

I= Air Quality Index
C= The Pollutant Concentration
C_{low}= Concentration breakpoint that is<C
C_{high}= Concentration breakpoint that is>C
I_{low}= Index breakpoint corresponding to C_{low}
I_{lhigh}= Index breakpoint corresponding to C_{high}

The air quality index and its impact on health as prescribed by the government is given below with proper color code

TABLE I. AIR QUALITY INDEX, HEALTH IMPACT AND COLOR CODE

Air Quality Index	Health Impacts	Color
Good (0-50)	Minimal Impact	
Satisfy (51-100)	Mild Breathing Distress	
Moderately Polluted (101-200)	Breathing Distress and discomfort to people with heart disease	
Poor (201-300)	Breathing discomfort to people on prolonged exposure	
Very poor (301-400)	May cause respiratory illness	
Severe (401-500)	Severe respiratory impact on people with lungs and heart disease	

Noise Pollution Level

Noise pollution has the most harmful impact on human or animal life. Noise pollution generally occurs due to the sound coming from honking cars, industries, factories, heavy machinery etc. Certain noise standards are prescribed by the government that need to be maintained.

TABLE II. STANDARD NOISE LEVEL LIMIT IN DIFFERENT AREA

Code	Area	Day Time	Night Time
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

The objective of our work is monitoring the air quality of a region and the detection of noise intensity to curb the problem of sound pollution. The proposed method involves cloud based monitoring of the required parameters with the help of internet.

Air Quality Index Monitoring

Air Quality Index is measured depending on five criteria pollutants, namely, ground-level ozone, particulate matter, Carbon monoxide, Sulphur Dioxide and nitrogen dioxide. In this project we are using MQ -135 AIR QUALITY or GAS DETECTION SENSOR. It efficiently detects the NH3, NOx, smoke and CO2 level in air. This specific sensor is chosen for its expansive detecting scope, fast response, reliability and long-term stability.

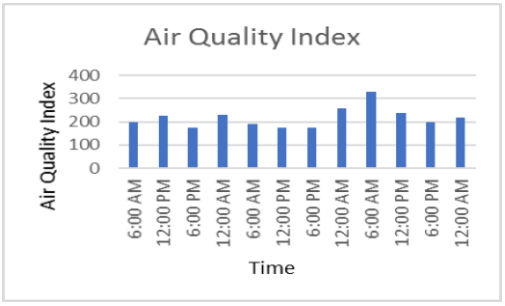

Fig.9:Air Quality index at a fixed Position for 72 hours

2) Sound Intensity Detection

LM393 Sound Detection Sensor is utilized to measure sound intensity with the motive to monitor Sound Pollution in an area. When sensor detects sound, it processes the output signal voltage which is sent to Raspberry Pi which again performs the necessary processing required for monitoring the parameters.

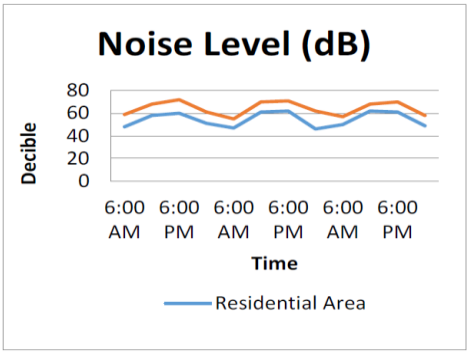

Fig. 10: Noise level in Decibel in two different places for 72 hours

3) Humidity and Temperature Detection

DHT11 Sensor is utilized to measure humidity and temperature in an area. The sensor detects the humidity levels and processes the output signal voltage, which is sent to the Raspberry Pi module.

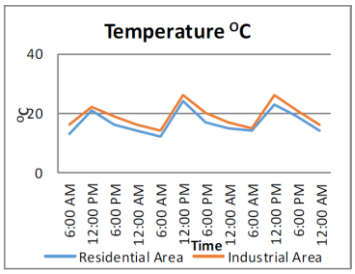

Fig.11: Temperature of two difference places for 72 hours

4) Uploading Data to cloud

For the incorporation of the cloud system we need internet access. We have added a GSM module to the system, so that the system can connect to the Internet using the mobile data. According to our needs we need to subscribe to a plan for the SIM we will be using in the GSM module.

5) Anomaly Notification

It acts as an Alert System. In the Raspberry Pi IDE, we use control statements for the incorporation of anomaly notification. If one of the parameters exceeds the desirable range of its digital value, steps are taken to send an E-mail and SMS to the specific authorities involved. Inside the control statement we give the proper mail body or SMS body, which needs to be addressed for an anomaly.

Conclusion

The Air & Sound Pollution management system is a further step to contribute a solution to the biggest warning. The air & sound monitoring system solves the problem of the highly polluted areas which is a main issue. It supports the new technology and effectively supports the healthy life concept. This system has features for the user to monitor the pollution level on their cell phones using the application. So, it becomes very dependent and efficient for the Municipal Corporation officials along with the Civilians to monitor habitat. It allows civilians to get involved in this process adds an more value to it. As civilians are now equally aware and curious about their environment, this concept of IOT is beneficial for the welfare of the society. And it is implemented using the latest technology.

Refrences

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