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Smart City Pollution Monitoring System Using Industrial IoT

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***ABSTRACT*: Technology is now a big part of our society and our foreseeable future and the progress of the human race is mostly due to the advancement in the technology. This progress often comes with an immense cost. It basically results in pollution and exploitation of earth.**

Hence, in the wake of severe pollution emergency in the world ,there is an urgent need to take immediate action to prevent people from succumbing to its adverse effects. So, we are introducing a system for detecting and monitoring the existence of the detrimental levels of sound and gases in the surrounding environment. This proposed system utilises the concept of "Internet of Things". An air sensor and a noise sensor will be incorporated into this system for tracking the harmful gases and noise levels in the atmosphere respectively. The information gathered here will be analysed and an alert will be sent to the user. A cloud server is also used for storing the pollutant's level for further usage. This system will be interfaced with Maps to display the pollution levels at the identified location to the user. This simulation creates awareness among people and allows them to take necessary precautions while travelling.

***KEYWORDS*: Air Sensor, GPS, GSM, IOT, Sound Sensor.**

I. INTRODUCTION

An Embedded system is a computer system designed for specific control functions within a larger system and often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. By contrast, a general-purpose computer, such as a personal computer (PC), is designed to be flexible and to meet a wide range of end-user needs. Embedded systems control many devices in common use today. Since the embedded system is dedicated to specific tasks, design engineers can optimize it to reduce the size and cost of the product and increase the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

As the world is getting modernised rapidly, internet technologies and wireless sensor networks are getting advanced and Internet of things(IoT) is one among them. Internet of things allows the exchange of information to and fro a device or a thing. A thing in the internet of things can be a person with a heart monitoring implant or any device that is connected to internet.

With the urbanization, industrialisation and with the increase in the use of vehicles, the atmospheric conditions have been considerably affected. The downside of this is pollution. Pollution is the introduction of impurities into the environment which can cause adverse affects. The different forms of pollution are air, water, noise and soil. and among these, air and sound pollution are most commonly faced and the major constituents which can lead to dire consequences on environment as well on human beings.

To overcome this issue, monitoring of these pollutions is very important. So, we are introducing an IOT based system in which the main objective is to monitor and detect the existence of detrimental levels of air and noise pollution in the environment. When the system identifies sound or air pollution, it activates and sends an alert to the authorized user about the pollution and the location where it has identified the pollution. So, that the user can take some precautionary measures for healthy life.

II. LITERATURE REVIEW

In the research mentioned in [9], in order to monitor the quality of air, a Wireless sensor network (WSN) based

new framework is proposed.A wireless sensor network contains several sensor nodes where in each node allows sensing, data processing and communicating etc. With the help of WSN, physical and environmental parameters can be monitored. Parameters of the environment to be monitored are temperature, humidity, volume of various gases like CO, CO2 etc. The data collected after monitoring is then passed through a network to a central location for close observation.Here, the network used for transmission is Zigbee Pro (S-2) and the central location is a base station. The value of temperature and humidity are transmitted over Bluetooth, so that everyone in the range of the system can check it over their devices likes smartphones and laptops which are connected to internet. Carbon Monoxide, a dangerous parameter is monitored with an extra care. Whenever its volume exceeds a particular limit, an alert will be sent to the base station.

In the research done in paper [2], an online GPRS-Sensors Array for air pollution monitoring has been proposed. This system composes of a Mobile Data-Acquisition Unit (Mobile-DAQ) and a fixed Internet-Enabled Pollution Monitoring Server (Pollution-Server). The Mobile-DAQ unit integrates air pollution sensors array, single-chip microcontroller, a General Packet Radio Service Modem, and a Global Positioning System Module. The Pollution-Server is a high-end personal computer application server which is connected over Internet. The Mobile-DAQ unit collects air pollution levels CO, NO2, and SO2 using the respective air sensors, and the GPS location ,time and date. This combined data will be stored in a frame. This frame is then uploaded to the GPRS-Modem. Then the information is transmitted to the Pollution-Server through the public mobile network. A database server is also affixed to the Pollution-Server for accumulating the pollutants levels for future usage by different clients such as vehicles registration agencies, environment protection authorities, tourists, insurance companies etc. The Pollution-Server is interfaced to Google Maps to display pollutants levels and locations in large metropolitan areas. This system is placed on top of a moving vehicle to collect data and was successfully tested in the city of Sharjah, UAE.

In this research, the main focus is on monitoring and detecting both air and noise pollution levels in the environment.There are two main reasons for particularly choosing these two pollutions. First reason is that the air and noise pollutions are most commonly faced by each person everyday in their day to day lives.Second reason is that the accidents or more like tragedies that has occurred in India in the past few years. Be it Bhopal Gas Tragedy or Vizag Gas Leak, these two would have been avoidable if the people living in the nearby areas had an easy access to sense and monitor the high levels of gases in the atmosphere.In this system, GSM is used instead of Zigbee technology as GSM works for wider ranges at considerably higher speed compared to Zigbee technology. This system can be accessed using a sim card of the user's mobile device to collect data. With the help of this system, not only the municipal authorities will have access instead every person with a mobile device will be able to access the information about the gases and sound.

III. SYSTEM ARCHITECTURE

The input to the circuit is applied from the regulated power supply. The ac input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating dc voltage. So in order to get a pure dc voltage, the output voltage from the rectifier is fed to a filter to remove any ac components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

To measure the quality of air, a MQ135 air sensor is incorporated which is capable of detecting and monitoring the presence of various harmful gases in the surroundings. This sensor gives output in analog format and operates on 5V supply. Sound Sensor (LC5) is also used to detect the noise levels whose frequencies are between 3 kHz 6 kHz.This sensor will then give the output in form of decibels.

Global System for Mobile communications (GSM) is an open, digital cellular technology used for transmitting mobile voice and data services which operate at 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. It can be used to make a computer or any other processor communicate over a network. This modem needs a sim card to be operated. Global Positioning System Modem (GPS) is used to calculate the user's exact location by using a technique called Triangulation.In this method, the GPS receiver will be measuring its distance from at least 3 to 4 satellites that surround the earth.After getting the data from those satellites, it will consider their intersection as the final GPS location of the user.

Microcontroller as the name suggests, is a small controller which contains a certain number of pins used as ports for giving inputs and receiving outputs. The Arduino Uno is a microcontroller board based on the ATmega328 P(datasheet). It has 14 digital pins and 6 analog pins. A 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button are also available.The 14 digital pins are used for input and output pins and the 6 analog pins are used only for inputs in this system. Aurdino can be connected it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The data which is provided by sound and gas sensor to the Arduino is displayed on the LCD display continuously.Then this gathered information can be uploaded to cloud for future use. This system uses an open source cloud platform called ThingSpeak for storing and uploading real-time sensor data. It has a channel through which data is sent for storage. This channel can be public or private based on the necessity. Each and every person who registers on this platform will be given a unique API key which is in turn used for communication between the device and the cloud.

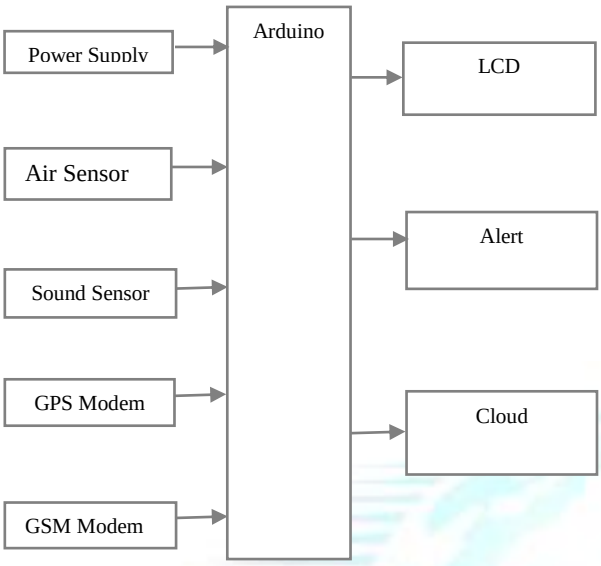
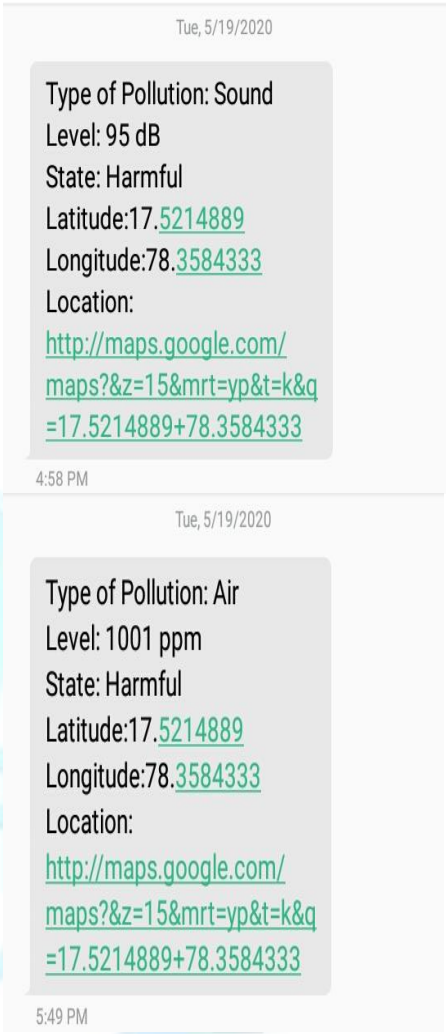


Fig.1.System Architecture



IV. WORKING

In this IOT based system, MQ135 air sensor is used to detect the presence of harmful gases like benzene, carbon dioxide, alcohol. Sound sensor called LC5 is used to sense the intensity of noise in the atmosphere. With the help of GSM modem, communication is established with the user's mobile device which in turn allows to send an alert to the user. GPS modem is used to detect the user's coordinates i.e latitude and longitude which is represented through a maps application.The outputs of these components will be given to the Arduino UNO which will process the received data and analyses it and will send the the alert the user. This alert contains the information about the type of pollution and the location at which it is detected. The information gathered is also upload to the cloud for future usage.. The data is also displayed on the LCD. Finally, when the user receives an alert he or she will be aware of the pollution and can take necessary precautions.

V. RESULT

The pollution monitoring system detects and monitors air and noise pollution present at the current location of the user. The user's location will be first identified which is then followed by the detection of the pollution in that area. It will then send a message to alert the user. This message will contain the information about the identified pollution and the GPS coordinates of that location. It will also send the location represented through Maps. This makes it easy for us to take necessary precautions while travelling through a pollution affected area. The following are the results:

VI. CONCLUSION

This IOT based air and sound pollution monitoring system is a great approach towards a healthy living of the individuals. With the help of this device not only the municipal authorities like earlier but even the common people can participate in the process of controlling pollution and ensure safe environment and livelihood. This automatic device, once installed is capable of continuously tracking the pollution level and analyse the detected information whenever necessary. The most highlighting feature of this system is that it alerts users regarding the pollution levels so that users can travel through the less polluted area or can take precautionary measures while travelling through the polluted area to reach the destination.

II. FUTURE ENHANCEMENT

In this system, the collected information is sent as an alert to the user only when the pollution identified is harmful instead we can also develop an android application to show the pollution levels and suggest some precautionary measures that the users can take for their safety .This device can also be interfaced with google maps or any maps application. This automatically shows pollution levels along with traffic, so

that the user will be able to take the shortest route which also has less pollution.

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