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Air Pollution Monitoring Using Low Cost Sensor with IOT LoRaWAN Connectivity

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ABSTRACT: Air pollution poses significant risk to environment and health. Air quality monitoring stations are often confined to a small number of locations due to the high cost of the monitoring equipment. They provide a low fidelity picture of the air quality in the city; local variations are overlooked. However, recent developments in low-cost sensor technology and wireless communication systems like Internet of Things (IoT) provide an opportunity to use arrayed sensor networks to measure air pollution, in real time, at a large number of locations. This work reports the development of a novel low-cost sensor node that utilizes cost-effective electrochemical sensors to measure carbon levels. The node can be powered either by solar-recharged battery or mains supply. It is capable of long-range, low power communication over public or private long-range wide area network IoT network and short-range high data rate communication over Wi-Fi. The developed sensor nodes were co-located with an accurate reference CO_2 sensor for field calibration. The system uses low cost air-quality monitoring nodes comprises of low cost semiconductor gas sensor with Wi-Fi modules. This system measures concentrations of gases such as CO, CO_2 , SO_2 and NO_2 using sensors. The fundamental aspect of proposed work is to provide low cost infrastructure to enable the data collection and dissemination to all stakeholders.

KEYWORDS: IoT, Wi-Fi

I. INTRODUCTION

Over the past quarter century, there has been an exponential growth of industries. These industries have caused complex and serious problems to the environment.Considering the significance of air quality on human lives, the World Health Organization (WHO) has developed guidelines for reducing the health effects of air pollution on public health by setting the limits of the concentrations of various air pollutants, some of which are ground–level ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).The first and the foremost is the severe environmental pollution which has caused deterioration of atmosphere, climate change, stratospheric ozone depletion, loss of biodiversity, changes in hydrological systems and the supplies of fresh water, land degradation and stress on systems of food producing, acid rain, and global warming Stationary and mobile sources release various chemical pollutants, including suspended particulate matter (SPM), carbon monoxide (CO), oxides of nitrogen (NO), oxides of sulfur (SO), lead aerosol, volatile organic compounds (VOC), and other toxics. It is well known that some of these chemical pollutants have increased the occurrence of diseases such as lung cancer, pneumonia, asthma, chronic bronchitis, coronary artery disease, and chronic pulmonary diseases . Hence, there is a growing demand for the environmental pollution monitoring systems. In view of the ever-increasing pollution sources with toxic chemicals, these systems should have the facilities to detect and quantify the sources rapidly. To overcome defects of traditional monitoring systems and detection methods and to reduce test cost, this work proposes a method combining IoT technology with environment monitoring.

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II. RELATED WORK

In 2017,S. MUTHUKUMAR; W. SHERINE MARY; S JAYANTHI; R KIRUTHIGA;M MAHALAKSHMI worked on "IoT Based Air Pollution Monitoring and Control System".Pollution related deaths increase every year and the leading factor for these deaths is air pollution. Air pollution is caused due to various elements among which pollution due to automobiles plays a pivotal role. Our work considers pollution due to automobiles and provides a real time solution which not just monitors pollution levels but also takes into consideration control measures for reducing traffic in highly polluted areas. 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 servers. This information can be used for traffic control.The proposed system also provides information about air quality through a mobile application which enables commuters to take up routes where air quality is good.In 2018,SWETA MAURYA;SHILPI SHARMA;PRANAY YADAV,"Internet of Things based Air Pollution Penetrating

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System using GSM and GPRS". In the last decade, the level of pollution is indomitable in urban areas. Due to this, the quality degrades day by day. Due to this researchers are focused on air pollution monitoring unit with the help of wireless sensor network. These sensor networks give the information of pollution level of the centralized server using the internet or telecom network. This paper proposed a reliable and low cost air pollution monitoring system for developing countries. Most of the developing nations where they don't have fourth generation high speed communication network but they require Air pollution monitoring system with the help of proposed monitoring system they could measure the level carbon monoxide (Co) and other pollution gas level in the form PPM. The proposed system is based on internet of things, global position system (GPS) and general packet radio servers (GPRS). Sensor collect data in the analog form and send microcontroller unit that is converted into an analog information in digital form and send this digital data to cloud server using GPRS system and store the data on cloud servers and then process this data. After the processing of this collected sensor data represented on http link that is based IP address and also create an APK file App presentation of this data. The proposed pollution measurement system shows low cost and better reliability as compared to other measurement devices that are shown in simulation and result.In 2020,YASSINE BEN-ABOUD;MOUNIR GHOGHO;ABDELLATIF KOBBANE,"A research-oriented low-cost air pollution monitoring IoT platform".This project presents an IoT platform designed for air pollution monitoring. It aiming to facilitate the testing of different data collection strategies, to simplify the air quality monitoring process, to provide the citizens with real-time information about air pollution, to allow citizens to participate in the air quality monitoring process, and to help the authorities identify zones of high air pollution and take the most appropriate measures to improve air quality. The sensor nodes have been developed using low-cost off-the-shelf hardware. Both nomadic and mobile sensor nodes have been developed. A novel sensor management middleware has been designed and developed to have the flexibility to remotely control the operational settings of the sensor nodes and to reduce the volume of transmitted data. Finally, two applications have been developed and implemented for data visualization. The first is a mobile friendly air pollution meter. The second offers a spatial visualization of air pollution levels using a Geographic Information System (GIS).In 2020,YINGSHENG CHEN;DEYUN CHEN;TINGTING SONG;KAI SONG,"An Intelligent and Portable Air Pollution Monitoring System Based on Chemical Sensor Array".With the development of urbanization, more and more attention has been paid to the problem of urban air pollution. The expansion of city scale results in the dynamic change of pollutant distribution. The monitoring equipment based on optical analysis instruments cannot meet the new demand of spatiotemporal dynamic monitoring of pollution gas distribution in the region. The portable air pollution monitoring equipment can realize the regional monitoring of pollutants and is easy to form a monitoring network. A prototype of a portable air pollution monitoring system based on a chemical sensor array is designed in this paper. The monitoring system is mounted in a portable case and can monitor the working state of the system and the process of gas measurement through the touch screen. The instrument can monitor the concentration of environmental pollution gas in real time and display the concentration change curve. It is also equipped with a 4G wireless module, which can transmit the pollution gas information remotely. The reliability and effectiveness of the designed monitoring system are proved by testing under laboratory conditions.

III. PROPOSED METHOD

In this proposed method, the Arduino UNO microcontroller is used To interface with the sensors and to the communication devices. The sensors which are used in this project are DHT11,MQ2,MQ7,MQ135.DHT11 sensor detects Temperature and Humidity from the atmosphere.MQ2 sensor detects Methane,LPG and smoke from the atmosphere.MQ7 sensor detects carbon monoxide level from the atmosphere.MQ135 detects Ammonia(NH3) level from the atmosphere.In this method, the LoRa module is used for transmitting and receiving data. LoRa stands for Long Range Radio and is mainly targeted for M2M and IoT networks. This technology will enable public or multi-tenant networks to connect a number of applications running on the same network.It is based on spread-spectrum modulation techniques derived from chirp spread spectrum technology.LoRa is a wireless technology that offers long range, low power and secure Data transmission for M2M and IoT applications. It will help us for long distance communication because of its modulation technique. The performance and coverage Result of the LoRa indoor and outdoor deployment is presented using a selected Combination of Spreading Factor and Bandwidth setting.

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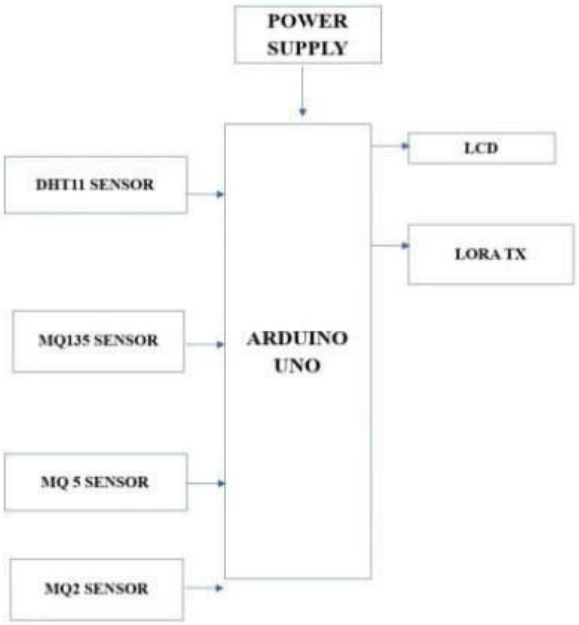
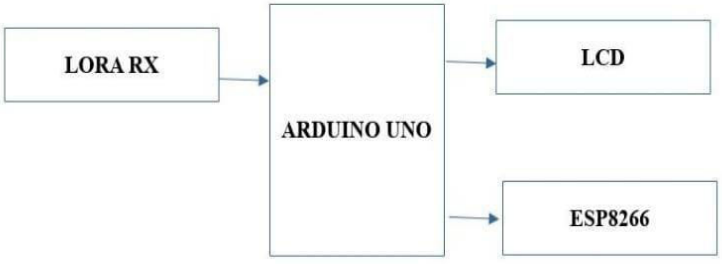
TRANSMITTER DIAGRAM:



Transmitter section block diagram

RECEIVER DIAGRAM:



Receiver section block diagram

IV. RESULT

This system is developed to monitor the quality of air in real time by using the data received from the sensors. The online application used to analyze air quality data obtained from sensors in this proposed system was "Thing-speak". Thing-speak is an open source internet of things application programming interface used to store and retrieve data from interconnected things using the hypertext protocol over the internet or via a local area network.

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fig 3,1 temperature and humidity

In this the temperature and humidity around the proposed system is monitored in real time. The data is immediately uploaded to the cloud and we can monitor the temperature and humidity in the thingspeak webserver with a delay of 16 seconds.

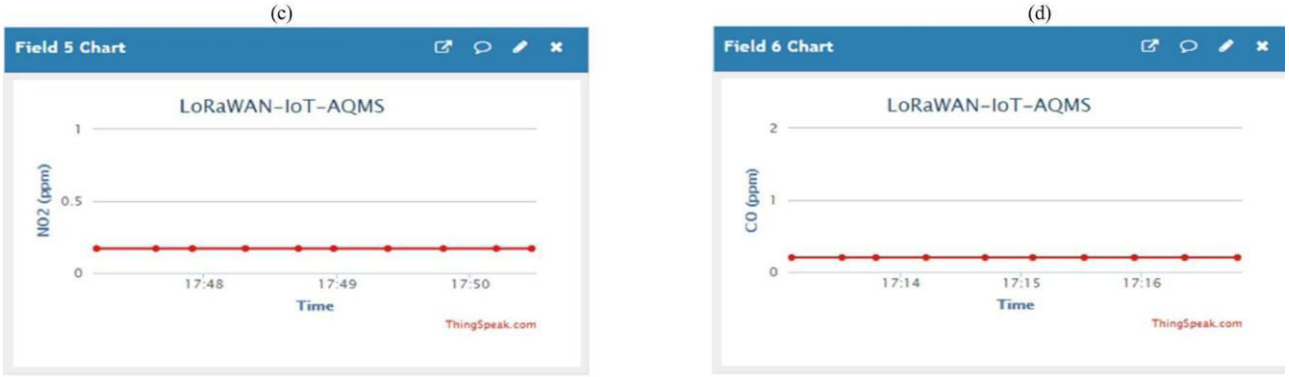

fig 3.2 NO2 and CO

The above figure shows the NO2 and CO values around the proposed system which has been uploaded to the cloud using LoRa and then received is being viewed in Thingspeak server. the above figure shows the data on the android application. It shows the concentration of various gases and dust in ppm along with the AQI.It also shows the quality of air based on AQI calculated by previous data of pollution in that area.

IV. CONCLUSION AND FUTURE WORK

There are some automated environmental pollution systems which are available, but they have some difficulties such as complex process, expensive and not being portable one. The proposed environmental pollution monitoring system overcomes the drawbacks of the conventional system. This smarter equipment is smaller in size, economical, has a better accuracy, it is compact and less complex in operation. This environmental pollution monitoring system is implemented for those who are having their cattle or sites in the remote locations or areas, by this they can get the real time values of toxic gases by in their own PC's continuously, so it is a professional supervision. This system would also be a feasible solution for those people who are struggling for data acquisition from their required remote areas.This project can help the individual to get information from any station which contain LORA configuration at any time. This project is supposed to work in remote areas to monitor pollution levels in the atmosphere by using some sort of sensor network. In testing stage it is tested in a remote area place. It can be extended to be used in any other places like industry purpose, military etc. to monitoring areas even in remote. Later on the system will have to be connected to LIFI.

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