Survey on Hazardous Gas Detection Using IoT Sensor Node

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Abstract : This paper offers the BLE 5.0 wireless technology and the Internet of Things(IoT) sensor node, which aims to monitor destructive environmental circumstances for safety applications. The proposed low-powered sensor node supports multiple environmental sensors. Sensor data is sent to mobile and to cloud server using BLE 5.0 based gateway.We focus mainly on the monitoring of ultraviolet, carbon dioxide, carbon monoxide and few environmental constraints. Bad environmental eminence can root serious health complications to peoples. Therefore, the neighboring environmental information is collected in real time by the wearable node and conveyed to distant cloud server. The information is then showed to approved handlers via web-based application on the cloud server, and when an emergency occurs, the device notifies the user via the mobile application. Experimental outcomes show that our safety monitoring system can operate consistently with less power consumption.

Key Words - BLE 5.0, sensor nodes, wireless sensor networks, Internet of Things, environmental monitoring, safety application.

I. INTRODUCTION

In both indoor and open air condition there are few air contaminations, for example, carbon dioxide (CO2), (CO)carbon monoxide and particulate stuff. In aeriation system CO2 is a common indicator. High level of CO2 in surrounding environment can lead to dizziness, headaches and detrimental symptoms of a range. when CO reaches above 35ppm it becomes poisonous to people. Fragmentary oxidation of carbon-containing mixes will make delivery of CO source. The gas may ignite partially. The mixture of small elements in the air is called Particulate matter(PM). Small elements with a diameter of 10 µA or less can be inhaled, causing thoughtful health problems in the lungs. articles less than 2.5 µm (PM2.5) can enter deeper into our lungs and may be more risky than large particles ranging from 2.5 to 10 µm (PM10). Particle sources comprise of forest resources, power plants, automobiles, organic compounds and also metals [2].

Wireless sensor network(WSN) is a promising solution for many monitoring applications together with structural health check [3], environmental monitoring [4], indoor air quality monitoring [5].The usage of the WSN in indoor air quality (IAQ) flexible in distribution and can decrease the costs of electrical wiring and related infrastructures. WSNs generally have strong power requirements for maintaining continuous monitoring. So, an effective power management and energy source should be carefully chosen.

Some of Air Pollutants and Effects are shown in table 1

TABLE I

AIR POLLUTANTS AND EFFECTS

Pollutant	Risk
CO	Fatigue, Headache, Impaired, vision, Coma, Brain damage, Death
CO_2	Headache, Dyspnea, Tremors, Increased heart rate and blood pressure, Convulsions, Coma, Death
O_3	Lung disease
NO_2	Adverse effects on the respiratory system
SO_2	Adverse effects on the respiratory system
Particulate Matters	Lung disease
VOC	Eye, nose, and throat irritation Headache Damage to liver, kidney and nervous system

Technical comparison of Bluetooth versions and other wireless standards are shown in table 2.

Feature	Bluetooth 4.x	Bluetooth 5	IEEE 802.15.4-ZigBee
Radio Frequency(MHz)	2400 to 2483.5	2400 to 2483.5	868.3900 to 928,2400to 2483.5
Distance/Range (meters)	Up to 100	Up to 200	Up to 150
Medium Access Technique	Frequency Hopping	Frequency Hopping	CSMA/CA
Nominal Data Rate(Mbps)	1	2	0.02-0.25
Latency(ms)	<6	<3	<4
Network Topology	Star-bus, Mesh	Star-bus, Mesh	Mesh
Multi-hop Solution	Yes	Yes	Yes
Nodes/Active Slaves	Unlimited	Unlimited	Unlimited
Message Size (bytes)	31	255	100
Certification Body	Bluetooth SIG	Bluetooth SIG	ZigBee Alliance

From table 2 we can say that BLE 5.0 is more compatible wireless technology for data monitoring system .Due to human error and machine failures etc gas leakage accidents occurs often but ceases many workers into death beds. Detection of gas leakages and harmful gases in and around industries and can be effectively handled by using sensors and automation using IoT. Here we develop a basic model for detecting hazardous gases and measuring harmful gases and informing the authorized user by SMS in case of gas leaks in all sectors of the industry.

II. LITERATURE SURVEY

[1] TOXIC GAS DETECTION AND MONITORING UTILIZING INTERNET OF THINGS

Authors- Dr. Chalasani Srinivas and Mohan Kumar.Ch
Year of Publication – December 2017

The project sought to avoid industrial accidents, detects hazardous like ammonia, carbon monoxide, nitrogen trifluoride, sulfur hexafluoride etc,, and also sends warning messages to the safety control board of industry gases by using Arduino Uno R3 and IOT. The sensors are connected to Arduino Uno R3 Microcontroller. Temperature, gas sensors, alcohol sensors can monitor respective environmental variable continuously. If the gas level rises above the normal level, an alarm will occur immediately, and the indication is displayed through an internet specific receiver section. The data received by the sensor can be stored on the Internet and used for further processing and can be analyzed to improve safety regulations. This model can be extended in the future to provide a better living environment for people both inside and outside the environment where pollution is controlled.
ESP8266-Based Serial Wi-Fi Shield for Arduino is used to transmit sensor data to cloud server.
Disadvantage: Wi-Fi based devices need a good battery backup if one wants to use them for more than 10hours or so, but Bluetooth consumes 25% to 100% less power than Wi-Fi.

[2] GAS LEAKAGE DETECTION AND SMART ALERTING SYSTEM USING IOT

Authors- Shital Imad, Priyanka Rajmanes, Aishwarya Gavali, Prof. V. N. Nayakwadi
Year of Publication – February 2018

This paper proposes a gas leakage system for the society with gas leak detector hardware on each plane. It detects hazardous gases from the environment and sends alert message to authorized users through alerts and dispatch notices. In this project a cloud connected smart LPG gas cylinder platform is designed and progressed, to avoid any possible accidents it acts as a protection device for sensing LPG gas leak at low levels. Sensing fire breakout in the zone and weight of the gas is possible from this system and it offers real time monitoring and alert over internet. The device sends an alert to smartphone app of the user and sends an alert e-mail to other authorities, if any nonstandard condition is detected.
Wi-Fi is used to connect devices to the internet and consequently increases the mobility of the platform inside the properties of the house. This device proposes real-time monitoring and remote control of gas leakages and prevention mechanisms in household and industrial areas which offers a whole low cost, powerful and user friendly method. The system is implemented by using a Wi-Fi capable ARM Cortex-M4 microcontroller.

[3] IOT based Hazardous gas Detection System using AVR Microcontroller
Authors- Pavneet Kumar, Akshyp Agrawal, Lalit Kumar, Vikas Kumar Jha
Year of Publication – March 2017

Hazardous gas detecting, ignitable and alerting system is developed in this project using AVR microcontroller. This project will be highly appreciated in the home and industry. Various leak detection techniques can be used for gas pipelines.

In this project, the data is transmitted over internet and text message is send to user's mobile number through GSM module. Ignitable hazardous gases are sensed using MQ-6 Gas sensor. 5v power supply is provided by a DC battery.
Software to AVR microcontroller is developed using Embedded C as well as assembly programming languages. The PROTEUS is used to stimulate the project on software.
Disadvantages: GSM wireless module consumes more power than Bluetooth Wireless module.
In this digital era we can use smart mobile application to display sensor data.

[4] HAZARDOUS GAS DETECTING RESCUE ROBOT IN COAL MINES
Authors- G BALA SIVA KRISHNA, T S KUMAR REDDY.
Year of Publication – May 2014

The mobile robot for mine rescue, calamity surveillance is planned and with its camera and additional components involved to it. A12V/4A rechargeable battery is used to run the robot. The robot was trial run and it moved freely well on debris and over uneven terrains and the video was conveyed with much clarity.
To check the performance, sensors are tested and conduct the test, by bringing any source of smoke near to MQ 7 sensor. The threshold value of CO2 for this prototype robot is set at 10 ppm and 70 ppm. 40 degree Celsius is the threshold for temperature. As soon as the measured value goes beyond the threshold value, a popup the monitor showing the parameters level has topped.

In this system they used ZigBee technology for communication between mobile robot and rescuer. To progress the security, Zigbee transceiver is used 2.4 GHZ RF band width and other frequencies can be used. Flame proof materials can be added in future. It can travel for a greater distance using advanced transmission and based on the transmission range it can be used in different environments. A much-improved image of the environment inside. Arm on the robot can be made to remove small debris from path inside the mine and to pick up samples.

[5] Bluetooth 5:a concrete step forward towards the IoT
Authors- Timothy Talty and Mario Coletta
Year of Publication – November 2017

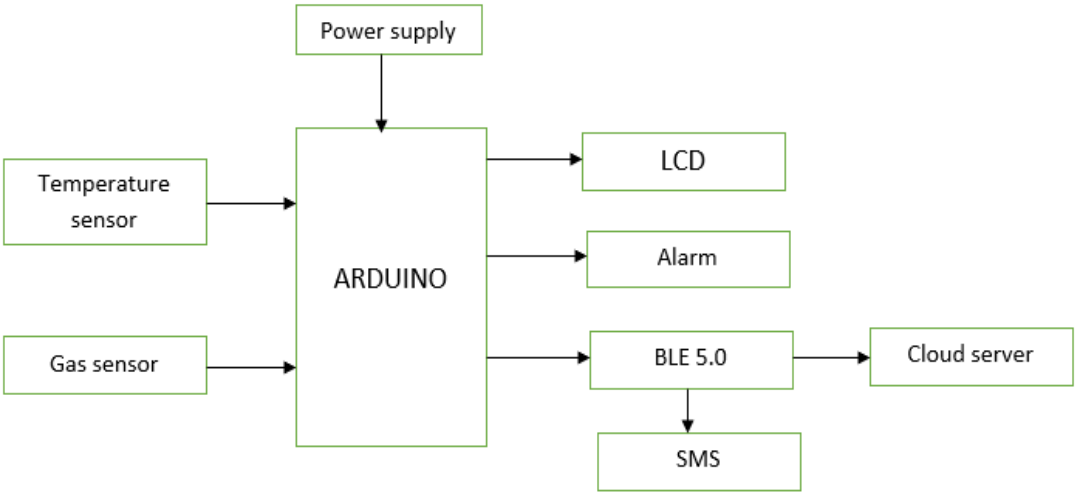
The main features of Bluetooth 5.0 has officially released by the Bluetooth special Interest group(SIG), a non-profit association that deals with the study and development of technology standards with those of Bluetooth. in short-range wireless communication technology it is one of the important developments.
This paper introduces the future use cases that justify the push for Bluetooth 5 and IoT scenarios. A set of new technical features of Bluetooth 5, their advantages and disadvantages are described.
Compared to the previous versions of Bluetooth, Bluetooth 5 aims to offer significant performance improvements, regarding speed, range, and broadcasting capacity. These new advantages might help BLE to be one of the best choices for IoT, in the fierce competition for dominating the IoT communication standard. Bluetooth 5 quickly attracted the attention of investors, especially start-ups and venture capital firms, who look with interest to the burgeoning market of the IoT.
Considering the significant improvements in speed, power consumption, range and capacity, it seems like Bluetooth 5 is a strong candidate.

III. ANALYSIS

From the above Literature survey we can analyse that the existing system to detect the toxic gases uses IOT and wireless technologies like Wi-Fi ,ZigBee with high data rate, range and frequency but these technologies consumes more power. In this generation with will sophisticated IOT technology it is very much required to manage the battery power and to do so we are using a new wireless technology called BLE 5.0.
Bluetooth 5 uses lesser energy resources. it can consume about two times less power than the previous version of Bluetooth. If the speed compared to previous version of Bluetooth it can consume about two times less power. If the speed of the wired device is doubled then the energy consumption will also double.

At 2.4GHz the Bluetooth operates and by this radio frequency the power consumption is dictated. Bluetooth 5 transfer same data as it exchanges twice the amount of data by consuming half the power. To become a competing technology within the living environment, compared to ZigBee Bluetooth has to be good technology wise. Since BLE 5.0 does not required access points or routers, its infrastructure costs has reduced. As a result, Bluetooth has good battery life compared to Wi-Fi.

IV. PROPOSED SYSTEM



In the proposed system gas sensors are used to sense hazardous gases like CO2 and CO from industries and are observed by the Arduino microcontroller and showed on LCD , data collected from the sensors are sent to cloud server through BLE 5.0 wireless communication and further used for data analysis. In critical situation, that is an alarm is engendered and authorized users receives an alert SMS when the CO2 exceeds from normal level. This alarm and SMS acts as an alerting system which is send through BLE 5.0 this helps in earlier diffusion of the dangerous situation.

CONCLUSION

In many industries with increasing necessities for safety and environmental shield the status of gas sensing increases. The existing system for gas sensing technologies has helped in a good way but the future has many new opportunities. Reduction in power and size will allow a new generation of devices. A wild variety of gas leakage detecting techniques is available, but they consumes more power so in this paper we are introducing a new wireless technology BLE 5.0 with new features like 50% reduction of power consumption, doubling the speed, the range of communication increasing by a factor of four, and broadcasting is boosted.

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