A SURVEY ON TOXIC ENVIRONMENT MONITORING USING SENSORS

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Abstract: **The level of contamination has increased with times by lot of factors like the increase in population, increased vehicle use, industrialization and urbanization which results in harmful effects on human wellbeing by directly influencing health of population exposed to it. Poor environmental conditions can lead to severe health problems. Nowadays people are affected by harmful gases in perilous environment. The important of this paper is observing harmful environmental conditions for safety applications. In this paper we detailed a survey on toxic environment monitoring based on different technologies using sensors.**

Index Terms: **Safety application, environmental monitoring, toxic gases, sensors, air quality monitoring, Wi-Fi.**

I. INTRODUCTION

These days harmful gases leakage is the main reason for industrial accidents and depths of workers in industries. Pollutants released by industries in to atmosphere is also a cause for the environmental pollution and such the reason greatly effects humans and animals health by minimizing the levels of oxygen and increasing the levels of harmful gases like ammonia, carbon monoxide, chlorine, nitrogen dioxide, hydrogen, flammable gas, methane and LPG. These gases are mainly the reason for increasing the no of pollutants in atmosphere. These environmental pollutants are mainly released by industries working with chemicals [1].

Industries management only have a eye on profits and consider environmental safety as least priority which in turn affects the atmosphere and industrial workers health who are living in and around industries as the level of harmful gases are high around industrial areas compared to normal living places. As the population depends more on usage of oil, gas and coal for generating energy to meet the energy demand by increasing population the release of harmful pollutants increases day by day .it is observed that about a 1.1 billion of human population respiration is done through unhealthy air and recorded 7 million deaths occur globally. Industries started peoples or industries owner fully focus on the profit oriented. They do not focus on the workers, people safety and environment safety also. Generally industries are located in the outside cities. But some industries are located at the middle of the cities and village because of the transport reasons or for the availability of raw materials [30].

Due to human error and machine failures etc gas leakage accidents occur often but ceases many workers in to death beds. Gas leakage and detection of gas leakages and harmful gases in and around industries and can be effectively handled by using sensors. Here we developed a basic model for detection of harmful gases and measurement of harmful gases on a self-calibrated ppm scale and notifying the workers of industry by sms in case any gas leakage is occurred in any sector of the industry [21].

The rest of this paper is organized as follows. In section II, we present the literature survey of toxic environment monitoring using sensors. In section III, proposed method of toxic environment monitoring. Finally, the conclusion is given in section IV.

II. LITERATURE SURVEY

We will detailed survey on toxic environment monitoring by papers are given below.

A wearable and wireless sensor system for real-time monitoring of toxic environmental volatile organic compounds [1]

The proposed method of this paper (1) presents a wearable and wireless system for toxic environmental volatile organic compounds (VOC), temperature, and relative humidity monitoring. A Bluetooth interface is used to transmit the data from the sensor device to a mobile phone.

Internet of Things based smart environmental monitoring using the Raspberry-pi computer [2]

The proposed method of this paper (2) presents for environmental monitoring using sensors. This system is able to accurately measure: temperature, humidity, light level and concentrations of the carbon monoxide harmful air pollutant. It's also designed to detect earthquakes through an assembled seismic sensor. This system to build a cost effective standardized environmental monitoring device using the Raspberry-Pi single-board computer. This system was designed using Python programming language and can be controlled and accessed remotely through an Internet of Things.

Speed-of- sound based sensors for environmental monitoring [3]

The proposed method of this paper (3) presents an overview of technology available to construct speed-of-sound based sensors for industrial applications such as environmental monitoring, leak detection. Monitoring CO_2 content in breathing apparatus, composition monitoring of anaesthesia gas mixtures to various leak detectors aimed at improving workplace safety. The sensors can be in form of industrial instruments, small IoT (Internet of Things) sensors or wearable MEMS (Micro-Electro-Mechanical Systems) based devices.

Sleep scheduling in industrial wireless sensor networks for toxic gas monitoring [4]

The author has suggested toxic gas monitoring using sleep scheduling algorithm for people safety applications in petrochemical plants. Industrial wireless sensor networks (IWSNs) are specially designed for industrial applications with improved efficiency, and remote sensing for toxic gas leakage. Sleep scheduling is a common approach in IWSNs to overcome the network lifetime problem due to energy constrained nodes. This paper propose a sleep scheduling scheme that ensures a coverage degree requirement based on the dangerous levels of the toxic gas leakage area, while maintaining global network connectivity with minimal awake nodes. The proposed scheme considers multiple hazardous zones with various coverage degree requirement. This paper describes that at the expense of a slight extra message overhead, energy consumption interms of totally awake nodes over the entire sensing field is reduced compared to other approaches, while maintaining network connectivity.

A Neural network approach for safety monitoring applictions [5]

The proposed method of this paper (5) presents for safety monitoring of dangerous gases in the industrial plants. A single artificial neural network is used for determination of the gas concentrations based on sensor array measurements, performing at the same time compensation of the temperature and humidity influence on the sensor outputs.

IOT based urban climate monitoring using Raspberry pi [6]

The proposed method of this paper (6) presents an urban climate environment monitoring which include the parameters like temperature, humidity, pressure, CO and harmful air pollutants. This system using low cost low power ARM based mini-computer that is Raspberry Pi. The use of the low cost mini-computer Raspberry Pi makes it efficient and reliable. The system aids in the sustainable growth of the city and improves the lives of the citizens.

A mobile and low-cost system for environmental monitoring [7]

In this paper (7) the author presents a mobile sensor node is installed on a bicycle for environmental monitoring. The proposed system can monitor air pollutants including O2 and PM10. The wireless network utilize a ZigBee module.

Wearable environmental sensors and infrastructure for mobile large-scale urban deployment [8]

The proposed method of this paper (8) presents a wearable environmental sensor network for urban environment monitoring. It has seven environmental sensors including infrared temperature sensor, atmospheric pressure, accelerometer, temperature, humidity, ambient light, and inertial measurement unit (IMU).

Smart, low power, wearable multi-sensor data acquisition system for environmental monitoring [9]

The proposed method of this paper (9) presents a low power and wearable sensor network measuring CO2 concentration, the Earth's magnetic field, temperature and relative humidity monitoring. The sensor node is based on Bluetooth wireless node and powered by a rechargeable Li-ion battery. However, wearable nodes still require regularly recharging the battery, which is inconvenient.

A wearable wireless sensor network for indoor smart environment monitoring in safety applications [10]

The author presents a wearable safety application, which allows early detection of hazardous situations for exposed workers. It can detect CO2, temperature and relative humidity. The wearable system is based on the XBee DigiMesh module and is powered by a (800 mAh) Lithium Polymer battery.

Air quality monitoring system based on IOT using raspberry pi [11]

The proposed method of this paper (11) presents a real-time standalone air quality monitoring system which includes various parameters: PM 2.5, carbon monoxide, carbon dioxide, temperature, humidity and air pressure. Internet of Things converging with cloud computing offers a novel technique for better management of data coming from different sensors, collected and transmitted by low power, low cost ARM based minicomputer Raspberry pi.

Environmental monitoring through embedded system and sensors [12]

The author presents an embedded and standalone system that can monitor, store and analyse environmental data as well as calculate energy consumption and determine and designate environmental spaces, in which human activities could be harmful using Wireless Sensor Network (WSN). Collecting and analysing data can help us estimate the environmental consequences of human actions.

Design and development of online system for monitoring harmful gas in animal house [13]

The author proposes an electrochemical sensor was designed to monitor the harmful gases like ammonia and hydrogen sulphide at different areas in the animal house. This system was tested in the animal house for monitoring the concentration of ammonia and hydrogen sulphide. This system could reach 95% experimental results implied that the communication success rate between the system node and collector and the sensor could be continuously monitored the change of harmful gas and also control the ecological environment in the animal house.

IOT based garbage monitoring system [14]

The proposed method of this paper (14) presents a IOT based garbage monitoring system which will help to keep the cities clean. This system monitors the garbage bins and informs about the level of garbage collected in the garbage bins through a web

page and also indicates the status of toxic gas formation inside the bin. The system uses ultrasonic sensor placed over the bins to detect the garbage level. GSM is used for sending data and a buzzer. The Organic Light Emitting Diode (OLED) screen is used to display the status of the level of the garbage collected in the bins.

A portable colorimetric array reader for toxic gas detection [15]

The author developed a portable array reader to interact with smartphones. This array reader can detect the color changes of the colorimetric strip responding to various hazardous gases through the complementary metal oxide (CMOS) image sensor. The array strip responding to toxic gases consist of dyes that change color based on the acid-base reaction. Therefore, the dye color changes according to the acidity, and the array reader monitors the color change in real time to create chrominance data. In this experiment, the array reader was evaluated by detection of ammonia, methylamine, and trim ethylamine (TMA).

Human safety system in drainage, unused well and garbage alerting system for smart city [16]

The main objective of this work is designing microcontroller based toxic gas detecting, alerting system and gas purification. Most of the drainage and unused wells are forming toxic gases. The hazardous gases like H_2S, CO, and CH_4 will be sensed and displayed each and every second in the LCD display. If these gases exceed the normal level then an alarm is generated immediately and also an alert message (SMS) is sent to the authorized person through the GSM. The garbage alerting system is used to control the air pollution. All the gas sensor values are continuously monitoring through the mobile application using Wi-Fi module. This system make a city smart as well as reduce the human death.

Gas monitoring and testing in underground mines using wireless technology [17]

The proposed method to create a mine gas detection system that will consist of gas detecting sensors, a wireless network provider and a microcontroller. MQ-4 and MQ-7 will be used for the detection of CH_4 and CO respectively. The wireless network will be provided by using Zigbee wireless network. This paper have discussed the places in the mine where the sensors will be installed and the steps that has to be taken by the required professional once the gas has been detected.

IOT enabled proactive indoor air quality monitoring system for sustainable health management [18]

This paper proposes an IoT based indoor air quality monitoring system for tracking the ozone concentrations near a photocopy machine. The experimental system with a semiconductor sensor capable of monitoring ozone concentrations was installed near a high volume photocopier. The IoT device has been programmed to collect and transmit data at an interval of five minutes over bluetooth connection to a gateway node that in turn communicates with the processing node via the WiFi local area network. The sensor was calibrated using the standard calibration methods. As an additional capability, the proposed air pollution monitoring system can generate warnings when the pollution level exceeds beyond a predetermined threshold value.

FPGA based real-time underground mine environment monitoring and warning system [19]

The author proposes the system design of a real-time underground mine environment monitoring and warning system using FPGA. This system detects the presence of harmful and toxic gases like Methane (CH_4) and Carbon monoxide (CO) and generates a proper warning. Verilog HDL is used to develop the design in FPGA. The main aim of the system is to read the data from the gas sensor interfaced to the FPGA board, compare with the pre-set threshold based on gas information and generate the warning signal. Vivado 2015.2 software is used for designing and implementing the system in Nexys 4 Artix 7 FPGA board along with other electronic components.

Wireless low power toxic gas detector based on ADuCM360 [20]

The proposed method of this paper (20) presents a toxic gas detector that monitors and stores the toxic gas concentration, temperature and humidity in the room for a long time. This paper describes the wireless low power toxic gas detector based on ADuCM360 with sensor technology and wireless transmission technology.

From the above surveyed paper, various techniques are used for monitoring toxic environmental conditions in people working hazardous environments. The techniques include sensors using toxic gases are monitored and it has some advantages and disadvantages interms of measured parameters for toxic environment monitoring. Firstly technique based on Bluetooth, Zigbee. These are low communication wireless technologies. It provided for short distance communication.

III. PROPOSED METHOD

In proposed method, Arduino based harmful environment conditions will be monitored by using sensors for safety applications. The toxic gases are forming in chemical industries, drainage, food wastes, and unused wells, vehicles etc. The ATmega328p from Atmel Corporation is selected as the micro-controller unit (MCU). It collects the data from different sensors and interfaces with the Wi-Fi. Environmental data will be monitored by the sensors in real-time and transmitted to a cloud server. The data can be displayed to users through a web-based application. The device will alert the user via a mobile application when an emergency condition is detected using GSM.

Components Used

- Temperature Sensor (LM35)
- Carbon monoxide Sensor (MQ7)
- Hydrogen Sensor (MQ8)

- Methane and LPG Sensor (MQ9)
- Flammable gas and smoke sensor (MQ2)
- Arduino (ATmega328p)
- GSM
- Wi-Fi

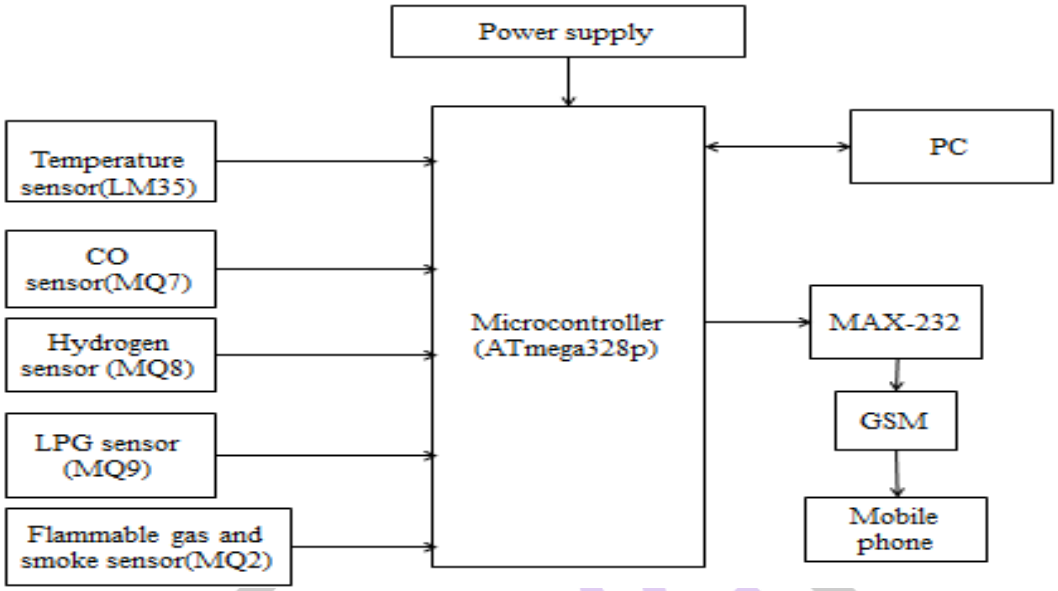

Fig 1 Block diagram of Toxic Environment Monitoring

The block diagram fig 1 provides the component needed and the working flow of the project. There are five sensors connected to signal connecting circuits because the sensor gets the input has analog signal it may consists of noise added to it hence to remove those noise and allow only the necessary signal through it. These signals are converted to digital signal with use of analog to digital converter. These converted values are given to Arduino IDE where the predefined values are set. When the sensed values cross the predefined values, the mobile will alert the user using GSM technology.

IV. CONCLUSION

Various kinds of techniques have been adopted for harmful environment monitoring has been surveyed. WSNs have recently received quite attention in the context of environmental monitoring as presented in the literature. In both environment indoors and outdoors, people are exposed to air pollutants emitted by houses, equipment, factories, vehicles etc. This paper targets the sensors based environmental observing research area. A wide variety of such systems have been developed and implemented recently, driven by the need to obtain air quality estimation with the minimum cost possible. In this paper, a review is provided which discusses the existing environment monitoring systems. This paper points out several research oriented problems that need to be addressed before environmental monitoring applications can be effectively implemented in practice.

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