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A Cyber -Physical System for Industrial Air Pollution Monitoring using Raspberry Pi

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Abstract: **-** In this paper the proposed system will focus on the monitoring of air pollutants concentration with the help of combination of Internet of things with wireless sensor networks. The analysis of air quality can be done by calculating air quality index. This information will be displayed on the webpage via internet in real time. By the combination of internet of things and wireless sensor networks for purpose of air pollution monitoring it becomes easy to keep the air quality data updated in real time. Also the system is cost effective which make its installation possible in various areas. The system existing before was based on microcontroller based toxic gas detecting and alerting system and the developing system will have a complete monitoring system which is IOT based. Also the information will be directly sent to the internet from system; no need of computer for transmission purpose which reduces the cost further. The main objective of this system is to monitor air pollution by using internet of things application. Also to obtain cost effective system that will help to keep track of concentration of pollutants in air and find effect of concentration of pollutants on air in terms of air quality index to achieve real time monitoring by continuously updating the data on webpage via internet.

Keywords- *Internet Of Things(IOT), Raspberry Pi, Air Qualioty Index etc.*

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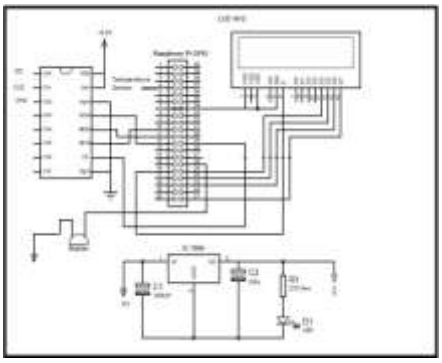
I. INTRODUCTION

Air pollution not only brings serious damage to human health but also causes negative effects to natural environments. Any activity involving burning things/fuels and mixing substances that cause chemical reactions may release toxic gases in the process and some activities in industrial field like construction, mining, transportation, etc. produce large amounts of dust which has the potential to cause air pollution. As generation of toxic gases from industries, vehicles and other sources is tremendously increasing day by day, it becomes difficult to control the hazardous gases from polluting the pure air. Air pollution not only brings serious damage to human health but also causes negative effects to natural environments. The air pollution occurs due to contamination of air with Carbon monoxide (CO), Carbon dioxide (CO2), Nitrogen dioxide (NO2), Sulfur dioxide (SO2) and many other harmful pollutants. This pollutant causes serious damage to environment. It also has hazardous effects on human health. Carbon monoxide reduces oxygen carrying capacity of the body's organs and tissues which may lead to cardiovascular disease. Carbon monoxide causes visual impairment, reduced manual dexterity, reduced work capacity, poor learning ability.

So it becomes more and more important to monitor and control air pollution. It will become easy to control it by monitoring the concentration air pollutant parameters in air. Using laboratory analysis, conventional air automatic monitoring system has relatively complex equipment technology, large bulk, unstable operation and high cost. This system can only be installed in key monitoring locations of some key enterprises, thus system data is unavailable to predict overall pollution situation. Using empirical analysis, conventional air automatic monitoring system has high precision, but large bulk, high cost make it impossible for large-scale installation. Nowadays, air pollution is monitored by static air quality measurement stations which are highly reliable and can measure the pollutants in air to a high level of accuracy and precision using analytical instruments, such as mass spectrometers, operated by official authorities. However, extensive cost of acquiring and operating such stations limits the number of installations. To monitor air quality, wireless sensor networks (WSNs) might be a great tool, because they can automatically collect air quality data. It will also help us to keep a working staff away from danger and a high security can be achieve and it will also help the Government authorities to monitor the air pollution.

II. ARCHITECTURE



III. WHAT IS RASPBERRY PI

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse.(Convert You Are TV In To Computer Using Raspberry Pi)

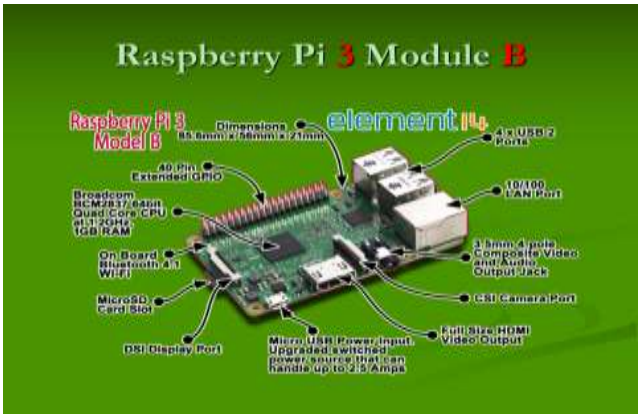


Fig.3.1 Raspberry Pi-3B Modle

Set up your Raspberry Pi 3B

The headlining feature of the Pi 3B is the built-in Wi-Fi and Bluetooth, but it doesn't stop there. Here's the complete specs for the Pi 3B Soc. Broadcom BCM2837 (roughly 50% faster than the Pi 2) PU: 1.2 GHZ quad-core ARM Cortex A53 (ARMv8 Instruction Set) Memory: 1 GB LPDDR2-900 SDRAM USB Ports: 4 Network: 10/100 MBPS Ethernet, 802.11n Wireless LAN, Bluetooth 4.0

IV. INTRODUCTION OF GAS SENSOR

Gas sensor is a subclass of chemical sensors. Gas sensor measures the concentration of gas in its vicinity. Gas sensor interacts with a gas to measure its concentration. Each gas has a unique breakdown voltage i.e. the electric these voltages. The concentration of the gas can be field at which it is ionized. Sensor identifies gases by measuring determined by measuring the current discharge in the device.

Discussion on some gas sensors:

Carbon monoxide(CO) gas sensor(MQ7)
Temperature sensor(DS18B20)
CO2 sensor-(MG811)
Methane sensor(MQ4)

4.1. Temperature Sensor

This is a pre-wired and waterproofed version of the DS18b20 sensor. They work great with any microcontroller using a single digital pin, and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them.

4.2. MG-811 for CO2 gas sensor

Features

Good sensitivity and selectivity to CO2
Low humidity and temperature dependency
Long stability and reproducibility
Application
Air Quality Control
Ferment Process Control
Room Temperature CO2 concentration Detection y

Sensitivity ：

Shows gas sensor sensitivity

Conditions: Tem ：28℃、

RH：65%、

Oxygen ： 21% EMF: sensor EMF under different gas and concentration.

4.3.MQ-7 Semiconductor Sensor for Carbon Monoxide

Sensitive material of MQ-7 gas sensor is CO which with lower conductivity in clean air. It make detection by method of cycle high and low temper at detect CO at low temperature (heated by 1.5V) .The sensor's conductivity get higher along with the CO gas concentration rising. At high temperature (heated by 5.0V), it cleans the other gases adsorbed at low temperature.User scan convert the change of conductivity to correspond output signal of gas concentration through a simple circuit.

4.4. MQ-4 Semiconductor Sensor for Methane Gas

Sensitive material of MQ-4 gas sensor is CH4, which with lower conductivity in clean air. When the target combustible gas exist. The sensor conductivity is more higher along with the gas concentration rising. Use simple electro circuit Convert change of conductivity to correspond output signal of gas concentration.

MQ-4 gas sensor has high sensitivity to Methane, also to Propane and Butane. The sensor could be used to detect different combustible gas, especially Methane, it is with low cost and suitable for different application.

Application Domestic gas leakage detector. Industrial Combustible gas detector. Portable gas detector

V. RESULT

Result analysis on the base of four parameters
1.Temperature
2.CO2(carbon dioxide)
3.CO(carbon mono-oxide)
4.CH4(methane)
Table:

Temperature	CO2	CO	CH4
32.19	6.00	8.00	9.00
32.94	6.00	7.00	8.00
31.06	9.00	21.00	10.00
30.00	7.00	5.00	9.00

IF pollutants gases are present then sensor monitoring the changes of values.

VI. CONCLUSION

Based on a study of existing Air quality monitoring system and scenario of air. We can say that proposed system is more suitable to monitor air quality parameters in real time. The proposed system introduces wireless sensor networking using several sensors to measure air quality, microcontroller and IOT module which make sensor network simple, low cost and more efficiently. Furthermore, to monitor data IOT environment is provided using raspberry Pi for creating gateway and also, cloud computing technology is used to monitor data on the internet. Moreover, to make system user-friendly web browser application is there. Therefore, the system will be low cost, faster, more efficient, real time and user friendly. Thus, we can fulfil aim and objective of the proposed system.

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