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Design & Implementation of Remote Monitoring System for Measuring Green House Gas Emissions at Landfill Sites and Industries Using Raspberry Pi2

K. Tharun Kumar Reddy[1], N. Kiran Kumar[2], Dr. G.N Kodanda Ramaiah[3]
[1](PG Scholar, Dept. of ECE, VIT/JNTUA, AP, India), [2](Asst. Professor, Dept. of ECE, VIT/JNTUA, AP, India)
[3](Professor and HOD, Dept. of ECE, KEC/JNTUA, AP, India)

Abstract : *The primary causes for the increasing global warming are the green house gases which are emitted from the major sites like Industries and Landfill (Waste Disposal) sites. So the proper monitoring of these sites is the prime concern. Because the long term exposure to these harmful gases cause severe heart and brain related diseases to the living beings. With proper monitoring of these sites especially the landfill sites, the awareness about the concentration of these gases emitted into the environment can be created to the peoples who are living around the landfill sites. The main aim of the proposed system is to develop a cost effective Remote monitoring system especially for the small area of landfill sites, which is capable to measure the temperature, humidity and pressure in the surroundings of the landfill site, concentration levels of the greenhouse gases like Methane (CH4), Carbon Dioxide (CO2) and Carbon monoxide (CO). The proposed system will send the information around the selected sites automatically to the respective authorities when the toxic levels exceeds the Permissible limits and also the public are allowed to access the system through "SMS" on demand service to know the concentration levels of the toxic gases around selected landfill site.*
Keywords - *Landfill sites, Gas sensors array, Raspberry Pi2, GPRS/GSM.*

I. Introduction

Due to rapid increase in urbanization coupled with industrialization during last few decades, there is a tremendous increase in municipal solid waste generation (MSW) in India. MSW generally includes Biodegradable Waste (Paper, food and kitchen waste), Recyclable material (metals, glass, bottles, cans) and toxic waste (e-waste, medication, fertilizer and pesticide containers).According to CPCB (Central Pollution Control Board) and IIR (India Infrastructure Report) reports, the annual MSW generation in India ranges between 40-55 million tons/year and it will reach 270 million tons in 2047.The trend of MSW generation in India is shown in figure 1.

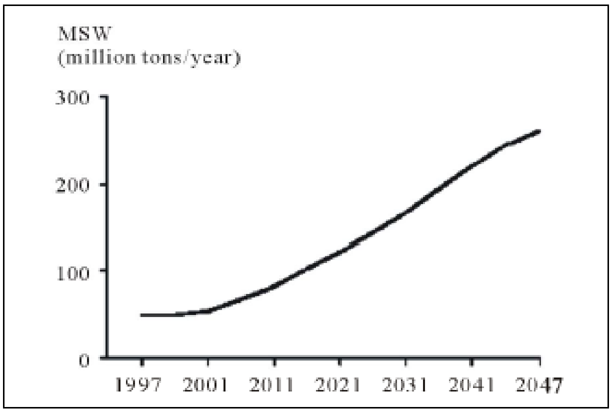


Figure 1. Trend of MSW generation in India.

Like any other country, in India too landfill remains the most popular method of disposal of MSW as landfill is more economic way of disposal of waste.

Landfills are becoming major pollution causing source in India. The lechate generated from the landfills pollute groundwater. Besides that green house gases (Methane-CH4, Carbondioxide-CO2 and Carbon Monoxide - CO) emission from landfills which causes for environmental degradation and also causes hazards to inhabitants. The green house gases are produced in landfills due to bacterial decomposition of organic waste. This anaerobic decomposition of MSW in landfills generates about 60% methane (CH4) and 40% carbon dioxide (CO2) together with other trace gases.

Moreover, that the global warning potential of methane is 21 times higher than that of Carbon dioxide and it has highest generation (60%) than other gases. The trend of methane emission is shown in figure 2.

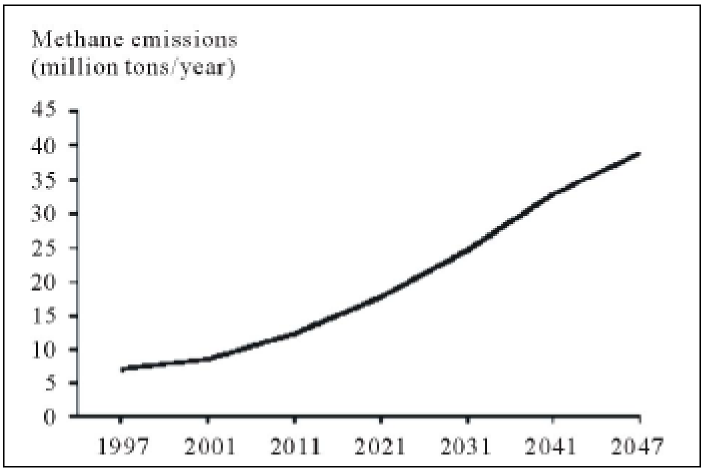


Figure 2. Trend of Methane emission in India

Unfortunately, many of these landfill sites have not been properly engineered and monitored. This leads to uncontrolled emission of trace gases, foul smell, bird menace, ground and surface water pollution etc. In this paper, we are measuring temperature, humidity, pressure and the concentrations of gases generated at Landfill sites. This system will send alerts to local authorities when a concentration level exceeds a safety level and also concentration levels are updated to web server.

II. Defining System Functionality

The main aim of this work is to measure the temperature, humidity, pressure and concentrations of Green house gases generated at land fill sites and industries. This system is designed by using raspberry pi. The system includes Raspberry pi2, different Gas sensors, temperature, humidity, pressure sensor, WIFI dongle and GSM/GPRS module.

The DHT22 humidity sensor and BMP180 pressure sensor are digital sensors hence these two are directly connected to the General purpose input output (GPIO) pins of Raspberry pi. Gas Sensors MQ5, MQ7, MQ135 are connected to the MCP3008 analog to digital converter (ADC) because the output of these sensors is in analog form, so to convert it into digital form that sensors are connected to the ADC followed by Raspberry pi2. The block diagram of remote monitoring system is shown in the below figure 3.

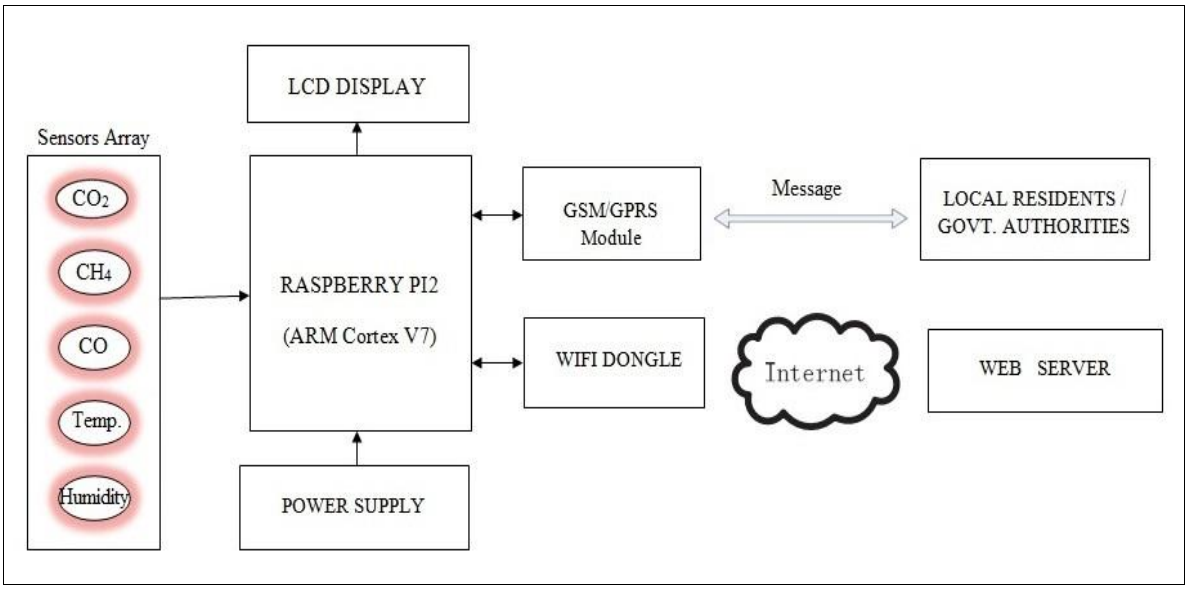


Figure 3. Block diagram of remote environmental monitoring system.

After getting the inputs from the sensors the Raspberry pi determines the level of gases concentrations, humidity, pressure and temperature. If the concentration level of gases are exceeds the safety levels, the warning SMS alert is sent to the concerned government authorities using GSM modem as well as the raspberry pi will upload the levels of gases, humidity, pressure and temperature to the internet using WIFI dongle where it can be read anytime anywhere.

III. Hardware Requirements

Raspberry Pi2:

The Raspberry Pi2 model B is the second generation raspberry pi. It has 1 GB RAM, four USB 2.0 ports, full HDMI port, 10/100 Ethernet port and 40 GPIO pins. It has a Broadcom BCM2836 system on chip which includes 900 MHz quad core ARM Cortex A7 CPU, digital signal processor, Video core IV 3D Graphics Core.

Figure 4. Raspberry Pi 2 (Model B)

The Raspberry Pi2 has camera interface (CSI) and Display interface (DSI). It has Micro USB power supply source. The power consumption of raspberry pi2 is 800mA, 4.0 Watts. The Raspberry Pi2 can run ARM Gnu/Linux distributions and also Windows 10.

Pressure Sensor (BMP180):

BMP180 is a barometric digital pressure and temperature sensor with I^2C interface. It is using Peizo-electric technology. The pressure range of BMP180 is 300-100 hpa. It will operate on voltages from 1.8V to 3.6V.

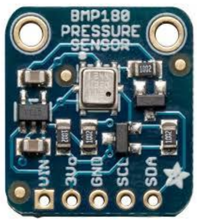


Figure 5. BMP 180 pressure sensor

Humidity & Temperature Sensor (DHT22):

DHT22 is used to measure both humidity and temperature. The output from the sensor is a calibrated digital signal which can be directly interfaced to raspberry pi2. It uses capacitive humidity sensor and thermistor to measure surrounding air and gives out digital signal on the data pin. It is more precise accurate and works in a bigger range of temperature and humidity.

Figure 6. DHT 22 Humidity & Temperature sensor

Methane Sensor (MQ5):

MQ5 is a semiconductor type Gas sensor which has high sensitivity to methane (CH4) and low sensitivity to cigarette smoke and alcohol, so here MQ5 is used to measure methane concentrations. It can measure methane concentrations from 300-1000 ppm. The tin dioxide is the sensitive material in MQ5.

Figure 7. MQ5 Methane sensor

Carbon Monoxide Sensor (MQ7):

MQ7 is also semiconductor type gas sensor which has high sensitivity to Carbon Monoxide (CO) so here MQ7 is used to measure CO Concentrations. It can measure concentrations of 10 to 10000ppm and outputs its reading as an analogue voltage. It will operate at temperatures from -10 to 500 C and consumes less than 150 mA at 5v.

Figure 8. MQ7 Carbon Monoxide Sensor

Carbon Dioxide Sensor (MQ135):

MQ135 gas sensor is used to measure Carbon dioxide (CO2) concentrations. . The sensitive material of MQ135 gas sensor is SnO2, which with lower conductivity in clean air. When the target combustible gas exist, the sensors conductivity is higher along with the gas concentration rising. It will convert change of conductivity to correspond output signal of gas concentration. The MQ135 gas sensor measures carbon dioxide levels in the range of 00 to 10000 ppm.

Figure 9. MQ135 Carbon dioxide sensor

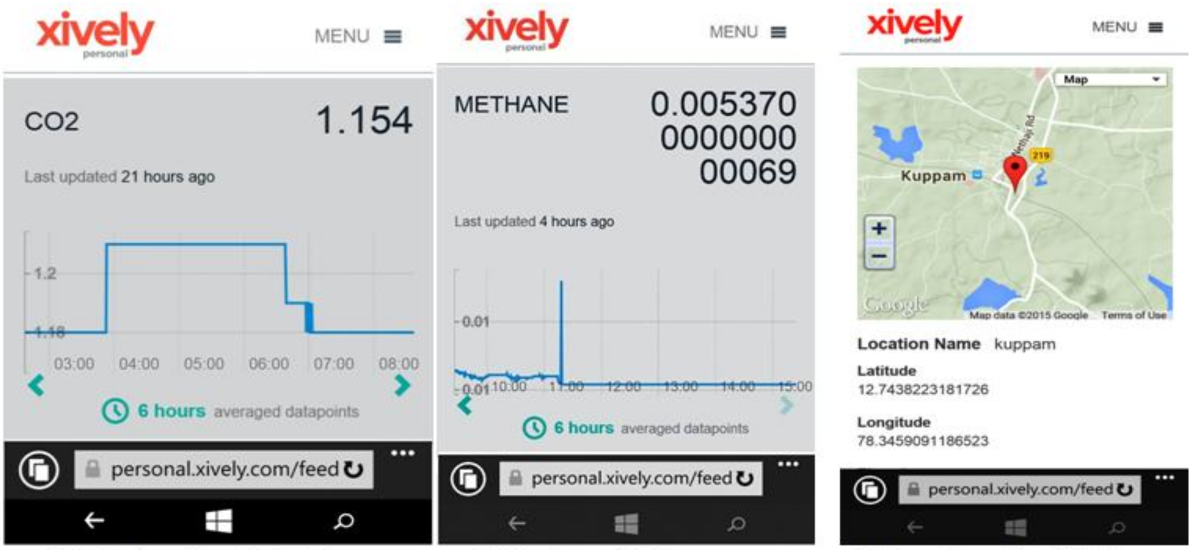
Analog To Digital Converter (MCP3008):

The MCP3008 is a10bit analog to digital Converter. It is available in 16 pin PDIP and SOIC packages. It has SPI serial interface, 8 input channels and on chip sample and hold. It samples at 200ksps and it has 10bit resolution.

Figure 10. MCP3008 ADC

IV. Results

The remote monitoring system is successfully verified at landfill site (open dumping site) in kuppam, Chittoor (dist), India with latitude of 12.743822 and longitude of 78.345909. The measured green house gases concentrations, temperature, humidity and pressure values are uploaded to the internet on a webpage (https:/personal.xively.com/feeds/1999131271). The graphs which are shown on web page are plotted by considering gaseous concentrations (ppm), temperature (^{0}C), humidity (%) and pressure (hpa) on **Y axis** and time period on **X axis**. The location and real-time values with graphs are updated to the webpage is shown in the figure 11.



(a) Carbon dioxide (CO_2) (b) Methane (CH_4) (c) location of landfill site

Figure 11. Screen shots of Uploaded gas concentrations and location of landfill site on a web page.

V. Conclusion

This paper describes the implementation of Remote Environment Monitoring System for Measuring Temperature, Humidity, Pressure and Green House Gas Concentrations at Landfill Sites and Industries. The semiconductor sensors are used to measure gas concentrations which are small, easy to use, reliable and have longer life time makes the Monitoring system Portable, reliable and can work at any atmospheric conditions.

The sensors data is analyzed using Raspberry Pi2, if concentrations exceed safety level, the SMS alert is sent to authorized government officials to take necessary actions and also the sensors data is uploaded to the internet using USB WIFI Dongle. The sensors data is successfully presented on webpage with graphs to visualize the data.

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References

[1]. Z. Mihajlovic, V. Milosavljevic, N Maodus, V. Rajs, M. Slankamenac, M. Zivanov, “System for monitoring concentration of NO2 and CO gasses on landfill sites”, Proceedings of the 35th International Convention MIPRO, Opatija, Croatia, pp. 183-186, 21-25 May, 2012.

[2]. S Manjula, P Ajay Kumar Reddy, M Lakshmipathy and K Bhaskar Reddy, “Mobile Data Acquisition for Air Pollution Monitoring Using Embedded System”, IJERT journal, Vol. 2 Issue 11, November, 2013.

[3]. N.kularatna and B.H. sudantha,”An environmental air pollution monitoring system based on the IEEE 1451 standard for low cost requirements”, IEEE sensors J., vol.8, pp.415-422, Apr.2008.

[4]. Živorad Mihajlovic, Vladimir Milosavljevic, Vladimir Rajs, and Miloš Živanov, “remote environment monitoring system for application in industry and landfill sites” 2nd Mediterranean Conference on Embedded Computing, MECO - 2013, Budva, Montenegro.

[5]. CPCB (Central Pollution Control Board), Management of Municipal Solid Wastes, 2005. Details available at <http://cpcb.nic.in/pcpdiv_plan4.htm>, last accessed on 5 July 2006.

[6]. IIR (India Infrastructure Report), Urban Infrastructure New Delhi, Oxford University Press, Oxford, 2006.

[7]. IPCC (Intergovernmental Panel on Climate Change), (2006). IPCC Guidelines for National Greenhouse Gas Inventories.

[8]. Kumar, I.P. Singh, S.K. Sud, “Energy Efficient and Low-Cost Indoor Environment Monitoring System Based on the IEEE 1451

[9]. Standard”, Sensors Journal, IEEE, Vol. 11, pp. 2598-2610, October, 2011.