Proceedings of the International Conference on Inventive Research in Computing Applications (ICIRCA 2018)
IEEE Xplore Compliant Part Number:CFP18N67-ART; ISBN:978-1-5386-2456-2

IoT based air pollution monitoring and control system

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***Abstract*— 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 take 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 server. 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.**

Keywords—air pollution;sensor; IoT;hardware;traffic control;

I. INTRODUCTION

In recent times the health of human beings has been directly impacted by pollution. According to statistics by Lancet, India has topped the list of countries with pollution-related deaths in 2015, with 2.51 million people dying prematurely in the country that year due to diseases linked to air, water and other forms of pollution [1].

The statistics is shown in Fig.1.According to The Lancet report, air pollution was the biggest contributor, linked to 6.5 million deaths in 2015, ahead of water pollution (1.8 million) and workplace-related pollution (0.8 million)[1]. Some of the air pollutants are SO_2, CO, CO_2, NO, volatile organic compounds (VOCs), particulates, chlorofluorocarbons (CFCs), etc [3].

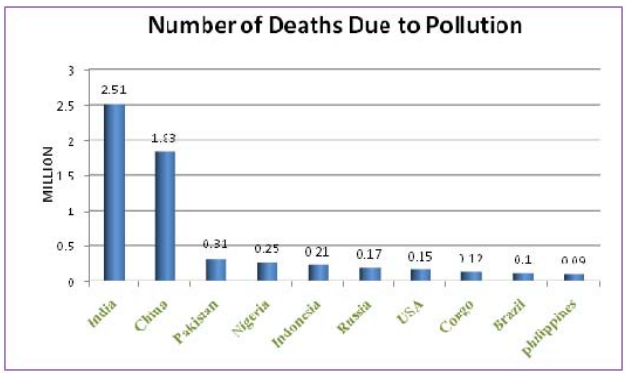

Fig.1.Statistics of death due to air pollution

Air pollution presents a serious threat to human health, especially in densely populated urban areas where the pollution levels continue to increase above the safe limits [9]. Statistics also show that about 30% of air pollution on an average is attributed to pollutants from automobiles. Such kind of pollution can lead to various health implications like heart and lung disorder.

The purpose of air quality monitoring is not merely to collect data but to provide the information required by scientists, policy-makers and planners to enable them to make informed decisions on managing and improving the environment, in addition to presenting useful information for public end-users [6].

Our work takes into consideration this growing problem of air pollution and provides a solution by constantly monitoring air quality and controlling vehicular flow if air is polluted beyond a threshold value.

India's capital Delhi is known for being one of the worst air polluted city in the world. Air pollution control was brought about by following the even odd policy of vehicles on road. Rather than blindly cutting down the number of vehicles on road, our system will ensure that vehicle traffic can be reduced or rerouted depending on the air quality.

Our work achieves this solution by installing independent modules which are to be placed on available infrastructure like lamp posts which also have solar panels. The module can be powered using solar power.

These modules contain sensors which acquires pollution statistics processes the same and transfers essential information to the server or traffic control station. This information can be used to reroute and control traffic in areas where air pollution is high.

II. PROPOSED SYSTEM

A. Block diagram

The block diagram of the proposed the system is shown in Fig.2.Our proposed system acquires inputs from various sensors which detect air quality. These acquired inputs are conditioned and provided to the control unit which processes these signals.

The algorithm in the control unit predicts the air quality and this information are transmitted to the traffic control station. Based on this information traffic can be regulated to control

air quality. This information can also be viewed using a mobile application. This additional feature allows users to follow less polluted routes thereby indirectly bringing down pollution in highly polluted areas. The use case diagram of the proposed system is shown in Fig.3.The technology stack of the proposed system is shown in Fig.4.

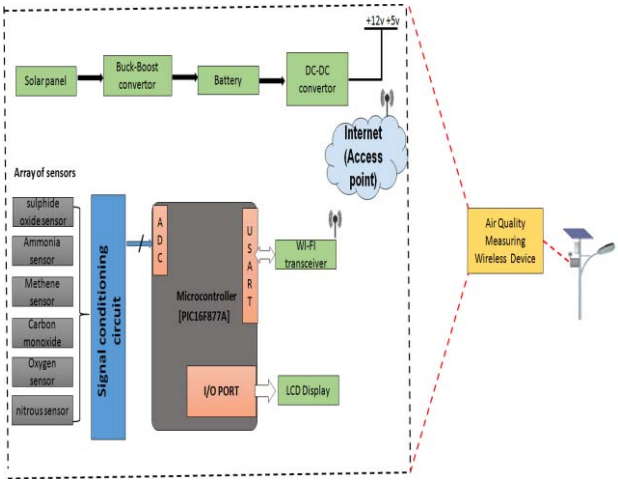

Fig.2.Block Diagram of Proposed system

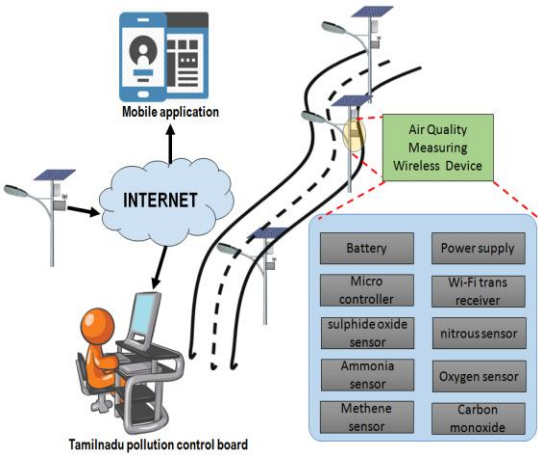

Fig.3.Use Case of proposed system

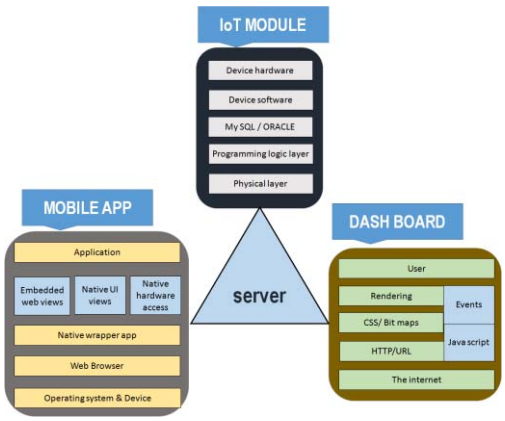

Fig.4.Technology stack of proposed system

B. Experimental Setup

The proposed system was developed using the PIC16F877A. The environmental setup for the developed system is shown in Fig 5.The work was prototyped and we have we considered sensors, MQ-7 which measures carbon-monoxide, MQ135-which measures ammonia, MQ4-which measures methane gas, and G37-for amount of oxygen. The sensor inputs are acquired and undergo signal conditioning.

The output from the signal conditioning circuit is then provided as input to an analog to digital converter of 10 bit resolution, which inputs these PIC16F877A.

The inputs are given to an air quality monitor algorithm which gets input values and compares them with threshold values.

The air quality information is then transmitted via a WiFi transceiver-ESP 8266 to a remote server from where this information can be accessed by the traffic control station.

This information can also be accessed through a mobile application. The designed system not only sends a message but also displays the status of the parameters of air quality through a CLCD display.

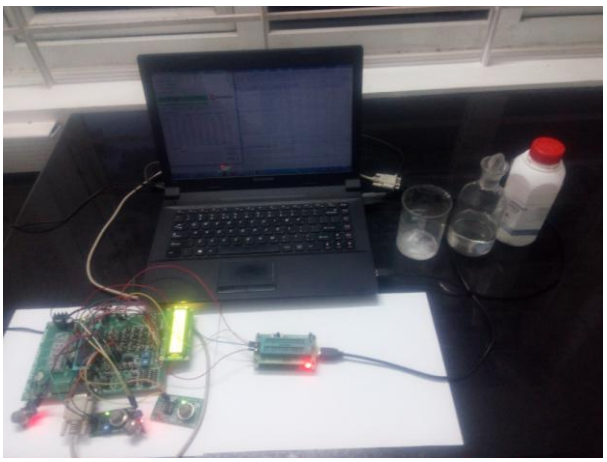

Fig.5. Environmental setup of proposed system

III. RESULS AND DISCUSION

A. Testcase

The proposed system was prototyped and tested. The system was validated using various test cases

Test case-1: Acquiring inputs from sensor
Test case-2: Processing data
Test case-3: Wireless Transmission
Test case-4: Display of gases present in CLCD.

Test case1 of proposed system in shown in Fig.6. Test case4 of proposed system in shown in Fig.7.

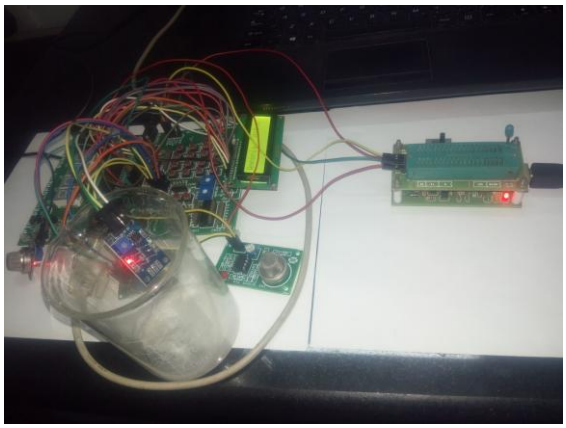

Fig.6. Test case1

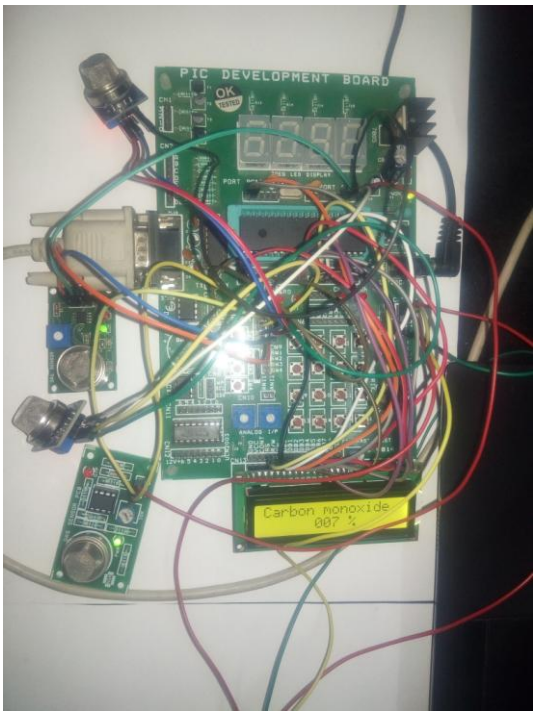

Fig.7. Test case4

IV. CONCLUSION

The proposed system was designed and tested. The proposed system measures the air quality of a particular area with the help of the hardware module fixed at certain locations like lamp posts. The proposed system collected real time pollution statistics using various sensors which monitored percentage of gases like ammonia, oxygen and carbon monoxide.

Using these inputs the algorithm predicted the air quality. Although there are a huge number of existing systems, the proposed system provides a unique feature by transmitting calculated information for traffic control purposes if air quality is detrimental. The additional benefit of the proposed system is the mobile application which will help the common man understand and be aware of the pollution status of localities. This awareness can also lead to people making a contribution directly to reduce pollution levels.

V. FUTURE WORK

The proposed system can be further optimized to consume less power as this will be a battery or solar powered module. This module can be deployed in all cities selected for the smart city project in our country. This will make our smart cities places where people can live a healthier life.

Acknowledgment

The authors would like to thank Er.C.Sukumaran for his constant encouragement. Special thanks for providing sophisticated laboratory facilities, for carrying out this work.
The authors would like to thank Dr.N.Kathiravan for his unconditional support during the design and development of the proposed system.

REFERENCES

[1] Anuradha Mascarenhas, ' At 2.5 million, India tops list of pollution-linked deaths: Study', Oct 20, 2017. [Online]. Available: http://indianexpress.com/article/india/at-2-5-million-india-tops-list-of-pollution-linked-deaths-study-4898337/ [Accessed: 11- Apr- 2018].

[2] SnehalSirsikar, PriyaKaremore "Review Paper on Air Pollution Monitoring System", International Journal of Advanced Research in Computer and Communication Engineering, Vol 4, Issue 1, January 2015.

[3] Raghavendra Khot, Prof.Vidya Chitre, "Survey on Air Pollution Monitoring Systems" International Conference on innovation in information, Embedded and Communication Systems(ICIIECS),2016.

[4] Khaled Bashir Shaban, Abdullah Kadri, Eman Rezk, "Urban Air Pollution Monitoring System With Forecasting Models" IEEE Sensors Journal, Vol. 16, No.8,April 15,2016.

[5] Bhavika Bathiya, Sanjay Srivastava, Biswajit Mishra, "Air pollution Monitoring Using Wireless Sensor" 2016 IEEE International WIE Conference on Electrical and Computer Engineering (WIECON-ECE) 19-21 December 2016, AISSMS, Pune, India.

[6] Abdullah Kadrl, Elias Yaacoub, Mohammed Mushtaha, Adnan Abu-Dayya, "Wireless Sensor Network for Real-time Air Pollution Monitoring" Qatar Mobility Innovations Centre (QMIC), Qatar Science and Technology Park, Doha, Qatar.

[7] Nihal Kularatna, B.H. Sudantha, "An Environmental Air Pollution Monitoring Systems Based on the 1451 Standard for Low Cost Requirements" IEEE Sensors Journal, Vol.8, No.4, April 2008.

[8] Marin B.Marinov, Ivan Topalov, Elitsa Gieva and Nikolov, "Air Quality Monitoring in Urban Environments" Technical University of Sofia, Bulgania.

[9] Theofylaktos Pieri , Michalis P.Michaelides, "Air Pollution Monitoring in Lemesos using a Wireless Sensor Network " Proceedings of the 18th Mediterranean Electro technical conference MELECON 2016,Limassol,Cyprus,18-20 April 2016.

[10] Chen Xiaojun, Liu Xianpeng, Xu Peng, "IOT-Based Air Pollution Monitoring and Forecasting System", 2015 International Conference on Computer and Computational Science (ICCCS).

Dongyun Wang, Chenglong Jiang, Yongping Dan, "Design of air quality monitoring system based on Internet of things" 10th International Conference on Software, Knowledge, Information Management & Applications (SKIMA), 2016.