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MONITORING INDOOR AIR QUALITY USING RASPBERRY PI PROCESSOR

Dr.M.V.Lakshmaiah[1], Syed Faiazuddin[2], Dr.K.Tanveer Alam[3]

Abstract- The parameters of the environment to be monitored are chosen as temperature, humidity, volume of CO, volume of CO2, detection of leakage of any gas - smoke, alcohol, LPG. The values of these parameters are transmitted by using Zigbee Pro (S-2) to a base station where they are being monitored. In order to monitor quality of air, a Wireless sensor network (WSN) based new framework is proposed which is based on data acquisition and transmission. The value of temperature and humidity are transmitted over Bluetooth also so that every person in the range of the system can check it over their smart phones and laptops as these parameters hold importance to everyone. CO, a dangerous parameter is monitored with an extra precaution. A text message is sent to the base station through GSM module whenever its volume exceeds a particular safe limit intended for a particular application. Indoor environments are characterized by several pollutant sources. As people typically spend more than 90 % of their time in indoor environments. This work describes the system (iAQ), a low-cost indoor air quality monitoring wireless sensor network system, developed using Raspberry pi Processor, XBee modules and micro sensors, for storage and availability of monitoring data on a web portal in real time. Five micro sensors of environmental parameters (air temperature, humidity, carbon monoxide, carbon dioxide and luminosity) were used. Other sensors can be added for monitoring specific pollutants. The results reveal that the system can provide an effective indoor air quality assessment to prevent exposure risk. In fact, the indoor air quality may be extremely different compared to what is expected for a quality living environment.
Keywords:- WSN, Air Pollution, Raspberry Pi2 Processor, GSM-GPRS, Bluetooth, Indoor air quality Indoor environment, Zigbee Gas sensors Smart cities.

1. INTRODUCTION

Internet-of-Things (IoT) has become very attractive in the modern wireless communications context. IoT implies “a worldwide network of interconnected objects uniquely addressable, based on standard communication protocols”. The development in embedded system has proved to a reliable solution in monitoring and controlling the environment monitoring system. The project aims at building a system which can be used on universally at any scale to monitor the parameters in a given environment. With the evolution of miniaturized sensor devices coupled with wireless technologies it is possible to remotely monitor the parameters such as temperature, Gas(co_2) in air and many more. In this context, integration of WSN with gas sensors will provide effective solution to observe, monitor and control the diverse critical units in AQMS. We will be using raspberry-pi as our main board and sensors will collect all the real time data from environment and this real time data will be fetched by the web server and display it.

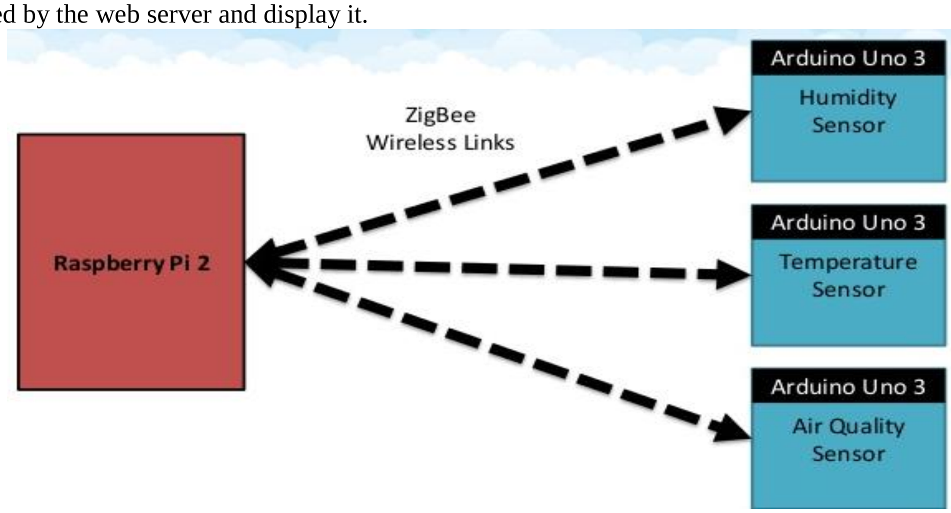

Fig 1: Utilization architecture of Raspberry Pi2 processor

[1] Head of the Department, Department of Electronics, S.K.University, Anantapuramu
[2] Research Scholar, Department of Electronics, S.K.University, Anantapuramu
[3] Assistant Professor, Department of Electronics, Rayalaseema University, Kurnool

User can access this data from anywhere through Internet. As shown in fig1: utilization architecture of Raspberry Pi2 processor will be very use full in industries in this system we have a temperature sensor and gas sensor's when any sensor's reaches the threshold limits it will send a notification to Twitter and also image will capture by the camera and sent alert mail to user can monitor.

- This application is very use full in industries.
- One of the main reason for global warming is carbon dioxide emission into the atmosphere.

2. ESTIMATION OF AIR QUALITY:

Basically, the main idea of the IoT is the distribution of ubiquitous "objects" or "things", which collect and exchange data in order to reach a common objective by means of mutual interactions.

In the Smart environment context, IoT might be used to address the air pollution problem, which has both social and economical relevance[1]. Carbon dioxide, ground-level ozone and particulate matter might cause asthma and respiratory diseases. Monitoring the air quality in the vital areas is one of the most challenging goals of modern-day society.

There are several traditional methods espoused for monitoring the emissions,

- Fossil fuel estimation and accounting raw material consumption,
- CO_2 flux measurement in air using IR radiation and
- Development of wireless sensor node and deployment of Wireless Sensor Networks based on the coverage area and scalability issues.

The authors present the implementation and the test of a real time environmental monitoring system using wireless sensor networks[2], capable of measuring temperature and greenhouse gas concentration levels such as CO, CO_2 and CH_4 levels. A WSN with 100 CO_2 sensing nodes was proposed in where collection tree strategy is as routing protocol and G-GSTWH algorithm is used for optimal node placement. Monitoring of air pollution due to vehicular emissions is proposed which is a peer-to-peer and grid architecture with two layer network framework is used for processing and ultraviolet radiations are used for detecting the pollutant gases. A WSN for industrial automation pollution monitoring and prevention is proposed in where the authors constructed the network to extenuate the damages caused by air pollution with 24 sensors, 10 routers and 1control server[3]. Air pollution monitoring with ubiquitous sensor networks is proposed in where a waspmote is connected with different gas sensor in a board and the data acquired is published through google maps.

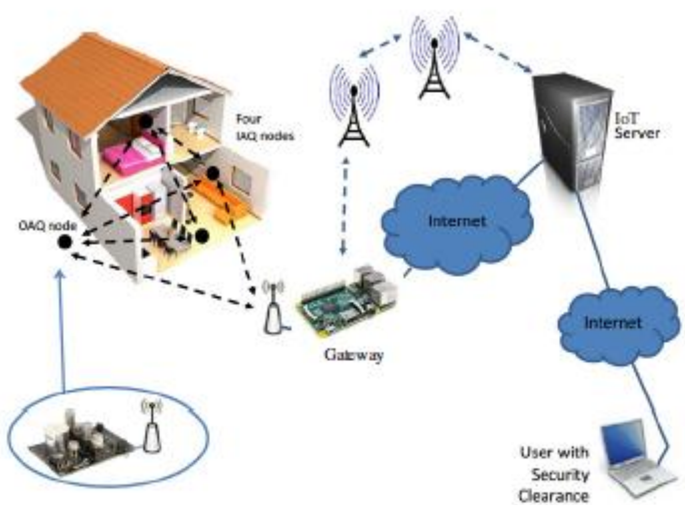

Fig 2: Architecture of the Proposed System

Present Polluino, a system for monitoring the air pollution via Arduino and they developed a cloud-based platform that manages data coming from air quality sensors. A comparison between two cloud computing service models and between two IoT communication protocols is performed. Figure 2 demonstrates the vision of the end solution for the indoor air quality (IAQ) monitoring and assessment.

3. MONITOR VOLATILE ORGANIC COMPOUNDS (VOCS) AND CARBONYLS:

In this research, we capitalize on the wide expertise of the collaborators in the area to develop a functional, scalable and reliable system for IAQ measurement. Although the work is related to IAQ monitoring and assessment of outdoor air quality (OAQ) in the vicinity of sample buildings to be used in the study is important and will be carried out. In the authors designed a new ZigBee network for IAQ monitoring system. They introduce an energy saving ZigBee WSN network with low latency and high throughput for the IAQ monitoring system, presented a wireless sensor network for JAQM[4]. The system combines knowledge from lower levels (sensors) up to the network level exploiting multimodality of the network by adding the people presence sensing. The aims of their study are to evaluate indoor and outdoor concentrations of NO_2, volatile organic compounds (VOCs) and carbonyls at 14 elementary schools in Lisbon, Portugal. The authors selected three schools to measure comport parameters, such as temperature and relative humidity, CO_2, CO, total as shown in fig3. VOCs and bacterial and fungal colony forming units per cubic meter. Primary results show that indoor concentrations of CO_2, in the three main schools, indicated inadequate classroom air exchange rates. Poor air quality may cause increased short-term health problems such as fatigue and nausea as well as chronic respiratory diseases, heart disease, and lung cancer.

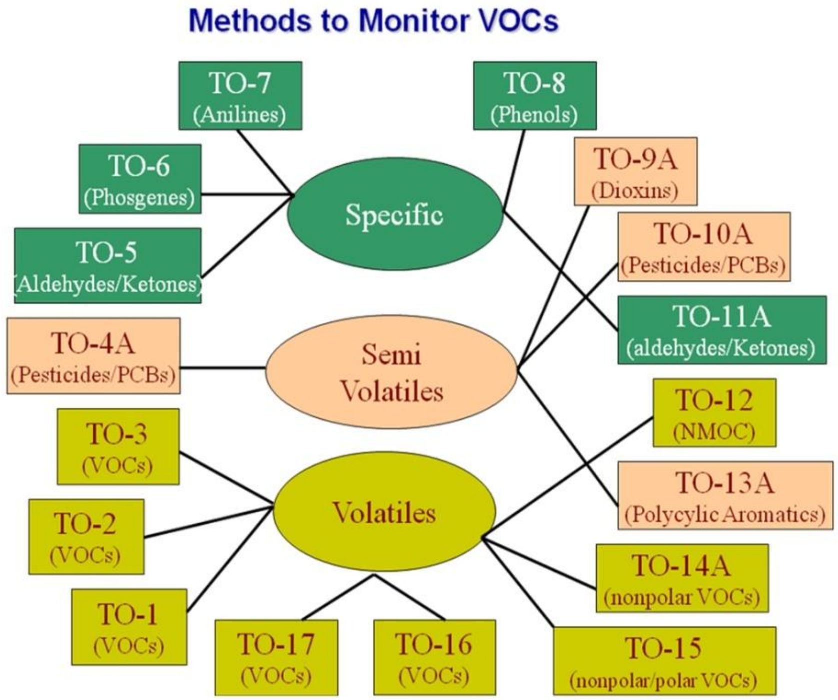

Fig 3: Methods to Monitor VOCs

According to the factors affecting the IAQ, and to the test items specified in the stadium hygiene inspection, the CO2 concentration, temperature and humidity are tested as the objective items, respectively using the ZG106 CO_2 detector, the DT-8892 professional temperature and humidity tester.

4. IMPLEMENTATION

The **iAQ** system is an automatic indoor air quality monitoring system that allows the user, such as the building manager, to know, in real time, a variety of environmental parameters as air temperature, relative humidity, carbon monoxide (CO), carbon dioxide (CO2) and luminosity. Other sensors for specific pollutants can be added[5]. The parameters are monitored using the **iAQ Sensor** system that collects data and sends it to the **iAQ Gateway** system that records the data in a MySQL database using web services developed in PHP. Owing to the evolution of SBC in the recent trends a miniature and low cost SBC called Raspberry Pi based on quad-core ARM Cortex-A7 cluster is selected as the principal hardware for web node. The grove sensors, grove DHT (for temperature and humidity), grove gas sensor modules like dust, MQ-5 (for smoke), MQ-7 (for CO) and MQ-135 (for CO_2) are interfaced to this shield for monitoring in our proposed system. Each sensor has various levels of concentration towards the corresponding gases at different temperature and relative humidity[6]. The Raspberry Pi runs with the operating system called as Raspbian, on which the necessary libraries are included and the drivers are developed for accessing the sensors. The drivers and the application scripts are developed using the PYTHON, which is a multi paradigm programming language that helps in rapid development and integration of the application with the systems[7]. An open source cloud IoT platform called Thing Speak is used as a cloud services for sensor web node. Apart from remote data monitoring, the Thing Speak cloud services also provides facilities for running aggregation, decision making and data analytics services[8]. The Thing Speak platform also offers other services like data visualizations with MATLAB support, alerts, scheduling and device communication. In our proposed model the data from multiple sensor web nodes are uploaded to the desired channels created for corresponding nodes. The channels are set to private or public view depending upon the requirement and austereness of the data for analytics, alert and reaction.

5. RESULTS AND DISCUSSIONS

The designed sensor node was deployed for monitoring the environmental air quality of both indoor and outdoor environment. Obtained sensor data's from each node are archived in the corresponding local database and ThingSpeak cloud database[9,10]. The local database is for remote monitoring, future retrieving and trend analysis. ThingSpeak cloud services are used for storing the data in the online cloud database mainly for running analytics services. Private and public view for the channel is configured in this cloud service and the measured data's are stored in the database. The data processing like plotting of data in graphs and analytics using MATLAB are carried out on the cloud database, so that the processing load on the sensor node is substantially reduced which makes the sensor node to maintain optimum power consumption. The data updated to the corresponding channels were analyzed in the real-time using MATLAB[11]. Based on the results of MATLAB analysis, the alert messages are published to the TWITTER account linked corresponding channel[13]. The complete application on Raspberry Pi is made to run at background periodically and it is automatically initiated after the boot process. Another script is made to run to check the network connectivity and re-establish the network connectivity for the deployed nodes.

6. CONCLUSION

Integration of WSN with IoT has made WSN as an invaluable resource to IoT as enounced in9,14. It can be concluded that the contrived Air Quality Monitoring System renders an efficacious integration between WSN and IoT, as a result a staple goal of remote monitoring the air quality in the specific area of interest has been attained and the same has become more user oriented. In this work the conventional application protocol "HTTP" is used for sending and receiving of data and the number of nodes is limited to four. The foci of the future work is on building module for calculating the air quality index as said in with the data aggregated from multiple sensor web nodes. Also to establishing the connectivity using IoT specific protocols like MQTT or COAP and also to increase number of node deployments so as to have broad coverage area.

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