

ASTHMA MONITORING USING WEB BASED INFORMATION SYSTEM AND WIRELESS SENSOR NETWORK

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ABSTRACT: Asthma is one of the widespread chronic diseases. Rising prevalence increases the burden of personal disease management, financial expenditures and workload, both on sides of patients and healthcare systems. According to the World Health Organization asthma is a serious public health problem with over 100 million sufferers worldwide. It continues to be one of the major causes of hospitalization of children in many countries. Asthma is the leading cause of absenteeism from school and the third leading cause of work loss. It ranks among the most common chronic conditions in the US, affecting an estimated 34.1 million persons in 2015. The number of reported adults and children diagnosed with asthma in 2015 was 17.5 million and 7.1 million, respectively. Moreover, the number of visits (to physician offices, hospital outpatient and emergency departments) with asthma as primary diagnosis in 2014-15 was 18.0 million. In the same year, the number of discharges with asthma as first-listed diagnosis was 456,000 with an average length of stay being 3.4 days.

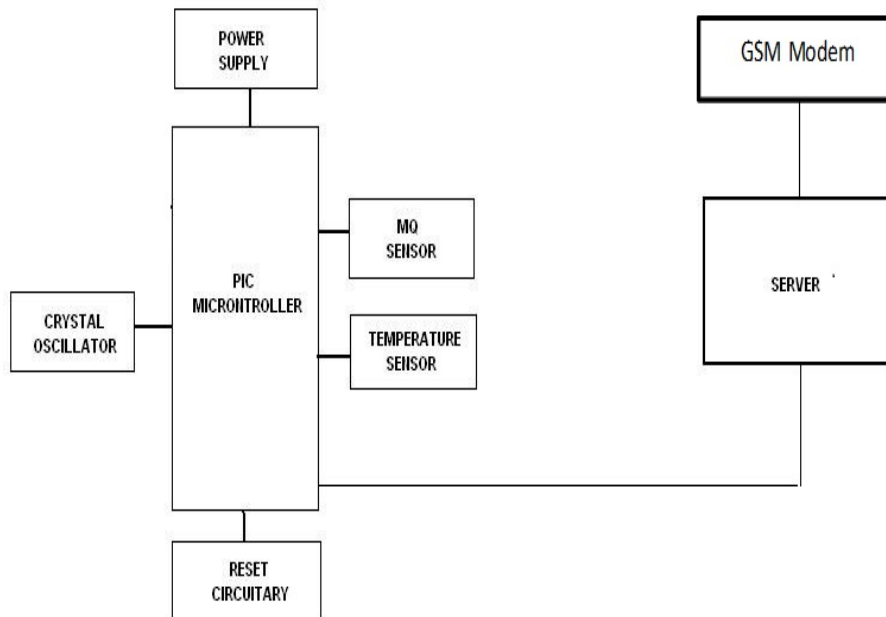


INTRODUCTION

In the new era of information technology, the people spend more time indoor considering their activities related work or leisure, indoor air quality conditions can affect directly the respiratory condition of the people. Thus, breathing air characterized by poor air quality will imply to bring air pollutants deeply in lungs, which causes serious damage to the respiratory tract. At the same time long term polluted air exposure can trigger new cases of asthma, Air pollutants also negatively and significantly harm lung development, creating an additional risk factor for developing lung diseases. At the same time the respiratory disease developed on young people are increasing, the asthma being one of the illnesses that is nowadays more frequent on children and teenagers. To investigate the relation between the indoor air quality and respiratory diseases, the measurement of gases concentrations such as CO, NO₂, PM₁₀ and physical parameters such as temperature and relative humidity are carried out. The air quality guidelines promoted by World Health Organization highlights the relation between asthma disease occurrence and factors such as smoking, mustiness, nitrogen dioxide. The usage of Wireless Sensor Network (WSN) to monitor outdoor and indoor air quality is reported by different authors however such solutions can still be considered limited regarding the flexibility and the possibility to include specialized measurement nodes based on accurate respiratory monitoring instruments as part of the deployed network.

The work presents a wireless sensor network and information system for air quality monitoring and periodic respiratory exams that is employed to extract relations between the air quality and respiratory disease such asthma. The data provided by the WSN may be published using a web based information system the information being accessed by users that can be alerted about the poor air conditions. The air quality monitoring network is based on Wi-Fi or internets that are relatively low cost solution, with high data rate transfer.

BLOCK DIAGRAM



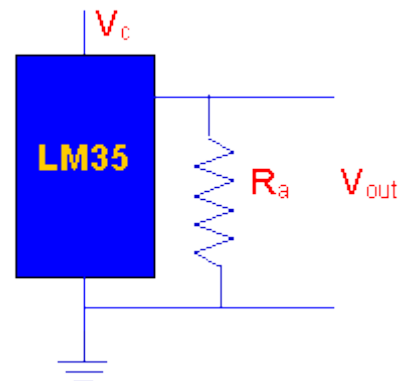
In this project, we are using wireless sensor network for indoor or outdoor air quality monitoring with application in asthma trigger factors assessment. The development of a flexible system is characterized by low-cost a sensing node that assures robust and continuous monitoring of air conditions in order to prevent the asthma attacks. At the same time it permits to establish correlations between the air quality parameters and the appearance of respiratory diseases such as asthma as part of environment medicine approach. The wireless sensor network includes a set of sensing nodes with ability to measure environment parameters like temperature, relative humidity, carbon monoxide among others and to send processed information to a smart coordinator.

It contain series of sensors for sensing temperature, carbon monoxide, alcohol, smoke and other toxic gases in the atmospheric air. PIC16877a is being used as microcontroller. In our software system we have a web service with client –server architecture. A web server based in PHP provides a minimal set of services, maintaining the security of system. A java client application requires the services. The java client application was designed to send data to a database and to receive data from coordinator the implemented application permits a highly robust response even if the client does not have internet connection at the moment. So, for this situation, the client application will save data received from nodes to a file and when the application could connect it will send data to the server database.

TEMPERATURE SENSOR

A temperature sensor is a device that gathers data concerning the temperature from a source and converts it to a form that can be understood either by an observer or another device. These sensors come in many different forms and are used for a wide variety of purposes, from simple home use to extremely accurate and precise scientific use. The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C) The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade

scaling. The LM35 does not require any external calibration or trimming to provide typical accuracies. The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies.



Circuit diagram of LM35

GAS SENSOR

Semiconductor sensors detect gases by a chemical reaction that takes place when the gas comes in direct contact with the sensor. Tin dioxide is the most common material used in semiconductor sensors, and the electrical resistance in the sensor is decreased when it comes in contact with the monitored gas. Semiconductor sensors are commonly used to detect hydrogen, oxygen, alcohol vapor, and harmful gases such as carbon monoxide. One of the most common uses for semiconductor sensors is in carbon monoxide sensors. They are also used in breathalyzers. Because the sensor must come in contact with the gas to detect it, semiconductor sensors work over a smaller distance than infrared point or ultrasonic detectors.

MQ-135 GAS SENSOR

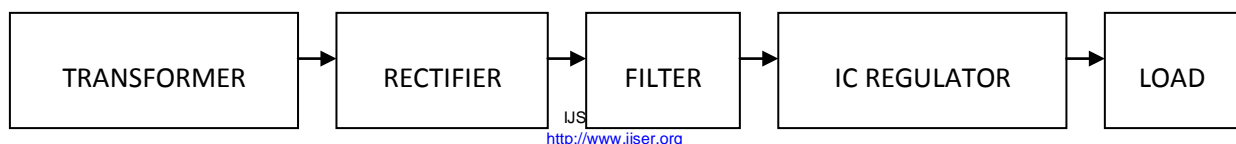


They are used in air quality control equipments for buildings/offices, are suitable for detecting of NH₃, NO_x, alcohol, Benzene, smoke, CO₂, etc.

POWER SUPPLY

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.



Block diagram (Power supply)

GSM MODEM:

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone.

For the purpose of this document, the term GSM modem is used as a generic term to refer to any modem that supports one or more of the protocols in the GSM evolutionary family, including the 2.5G technologies GPRS and EDGE, as well as the 3G technologies WCDMA, UMTS, HSDPA and HSUPA.

TOMCAT WEB SERVER

Tomcat is a Java servlet container and web server from the Jakarta project of the Apache Software Foundation (<http://jakarta.apache.org>). A web server is, of course, the program that dishes out web pages in response to requests from a user sitting at a web browser. But web servers aren't limited to serving up static HTML pages; they can also run programs in response to user requests and return the dynamic results to the user's browser. This is an aspect of the web that Apache's Tomcat is very good at because Tomcat provides both Java servlet and Java Server Pages (JSP) technologies (in addition to traditional static pages and external CGI programming). The result is that Tomcat is a good choice for use as a web server for many applications.

Tomcat can be used stand-alone, but it is often used "behind" traditional web servers such as Apache httpd, with the traditional server serving static pages and Tomcat serving dynamic servlet and JSP requests. Tomcat provides an environment in which servlets can run and JSP can be processed.

COMPONENTS

Tomcat 4.x was released with Catalina (a servlet container), Coyote (an HTTP connector) and Jasper (a JSP engine).

CONCLUSION

A wireless sensing network indoor and outdoor to monitor the air quality in relation with trigger factors detection associated with asthma attacks was developed. To support data representation and alarm generation a graphical user interface was developed such as a website. As important part of the system java application makes a bridge between the wireless sensor network and the database through Internet connectivity. Data from respiratory tests, imported using the developed java application permits to analyse the relationship between asthma and air quality.

The presented solution is useful to prevent asthma and other respiratory diseases in indoor spaces. The information can be accessed anywhere which allows the users to know elements about risk condition for their respiratory health. As the future work is mentioned and extension of the wireless sensor network, thus new nodes characterized by new capabilities air compounds concentration measurements as so as new capabilities on respiration activity monitoring. Referring to the information system side, in order to provide a more efficient alert system, the warnings can be sent as a SMS to cell phone of users, or by email.

The *web* based information system can be improved with new technologies that permit to be accessed using mobile devices such as smartphones or tablets. The principle of the

development of science is that “nothing is impossible”. So we shall look forward to a bright & sophisticated world.

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