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A Survey on Asthma Detection and Web Based E-Monitoring System.

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ABSTRACT

This Paper is presented to indicate the presence of automated wheeze detection based on the advanced features available for the asthma patients. Generally stethoscope is used to identify the presence of wheezes in the respiratory sound .There are certain drawbacks in this method since there is variation of the interpretation time which may cause certain difficulties , misinterpretations which may even lead to loss of life in case of chronic asthma patients. Therefore an automated asthma monitoring can lead to the continuous monitoring and accurate diagnosis of the patient which reduces the burden of the medical personnel. The presence of wheezes, their detection methods, are discussed in this paper. A further discussion of automated continuous monitoring of asthma patients is also discussed in the later part of this paper. Various hardware ,software their efficient working is also discussed clearly to encourage the future research work to develop a commercial system that will improve the efficient diagnosing and monitoring of the chronic asthma patients.
Keywords: Chronic, Auscultation, Wheezes, Dyspnea, Inflammatory.

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INTRODUCTION

Now a day's asthma is becoming a very big public health challenge in the world as it occurs to people irrespective of any age. Asthma is a chronic inflammatory disease of the respiratory airway passage and its severity differs with respective to the kinds of stimuli that causes it. Asthmatic patient suffers from severe cough, breathlessness, dyspnea and the major disorder is the wheezing. The respiratory sounds indicate the lungs health. Any changes in the respiratory sound may be due to the malfunction of the lungs or any difficulties in the airway path to the lungs which should be diagnosed to find the severity of the disease. In regard to asthma the symptoms generally originate from the oscillations that occur in the walls of the airway to the lungs. Wheezes are generally clinically referred to as abnormal respiratory sound that is present in the walls of the lungs .It is well known that auscultation with clinical stethoscope is fast, reliable, non- invasive and it cannot be used for the continuous monitoring of the asthma patient [1]. Due to the increase in the patients the demand for the automatic monitoring grows to diagnose and monitor the patients. For asthmatic patients continuous and automatic diagnosis and monitoring on daily basis would provide crucial data for the chronic treatments.

MATERIALS AND METHODS

Impulse Oscillometry

IOS (Impulse Osillometry) a testing method is used to identify the wheezes that are present in the asthma patient .This method [2] involves passing of rectangular electrical impulse through the external loudspeaker (as illustrated in figure 2.1) and driving it to move suddenly forward for about 30-40 msec which is then followed by passing 200 msec later in the similar manner but now in the backward direction. The speaker motion cause rapid change in the pressure of the patients mouth which is then analyzed with Fast Fourier Transform (FFT) into the spectral components range of 5-35 Hz. The resulting waveform is passed into the patient's mouth which is then super imposed on the normal breathing waveform of the patient. From these two waveform analysis the amplitude pf the spectral components is calculated. If they are in phase with each other (Resistance) and if out of phase (Reactance) is calculated .From which the respiratory impedance graph is drawn with respiratory resistance and reactance as functions of oscillation frequency (Figure 2.2).

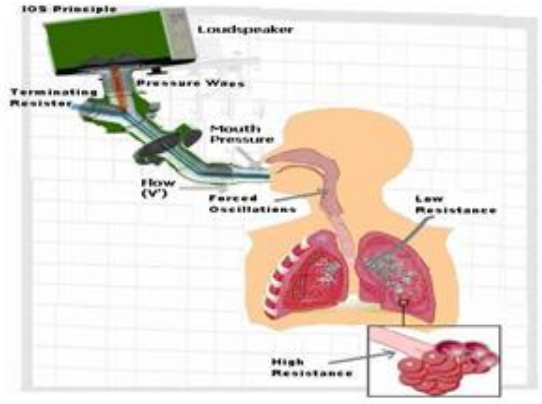

Fig 2.1: IOS testing Method [2]

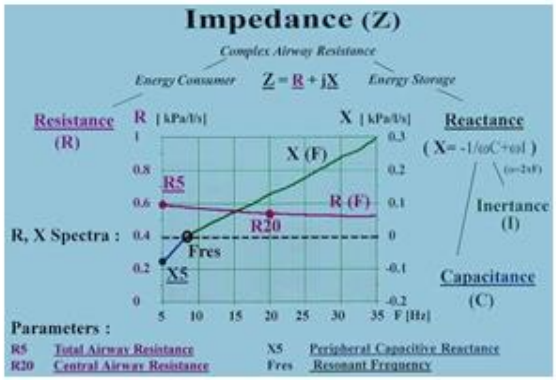

Fig 2.2 Respiratory Impedance and its reactance [2]

Early detection of pathological impairments in airway can be identified using the airway impedance which cannot be recognized by conventional lung function tests. Hence IOS is the best alternative for the traditional methods.

Artificial Neural Networks

Artificial neural network (ANN) acts just like the brain composed of many neurons which are interconnected with each other. Each artificial neuron is connected to the other neurons via unidirectional

signal channels called links each associated with weights W. The neuron will fire only when the threshold around it is reached. The most common and highly implemented algorithm is back propagation algorithm. It does 3000 iterations at a time. The ANN is simulated using C language to create a feed forward network with binary sigmoidal activation function. There are 16 nodes in the input layer, 16 in the hidden layer and 2 for the output layer as illustrated in Figure2.3

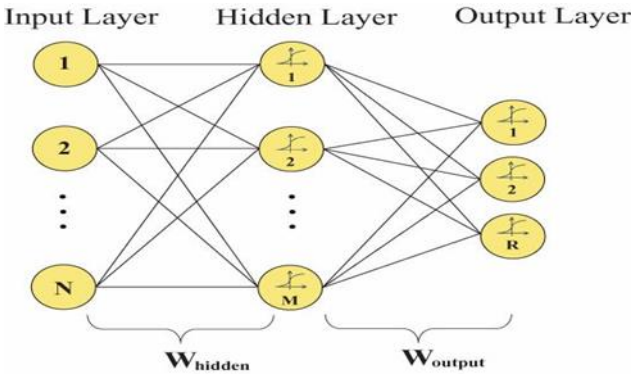

Fig 2.3: Architecture of the ANN [2]

The results for the simulated network are plotted as a function of relatively constricted and non-constricted asthmatic states. By using the optimum values of set to (0.8, 0.3), and training for 322 epochs, the ANN was capable of a generalization result with 98.61% classification accuracy. These results show that the network achieved notably high classification accuracy when categorizing new, previously unseen asthmatic and non-asthmatic Patterns.

Wireless Sensor Networks (WSN)

Wireless sensor networks (WSN) is being used in the air quality monitoring for indoor and outdoor areas which also monitors temperature, relative humidity and gas pollution. They use various nodes for this monitoring in the deployed nodal area network. The air quality monitoring can be done by using Wi-Fi or Bluetooth depending on the convenience of the network. Bluetooth and zigbee protocols are being widely used in the environment monitoring systems. Zigbee has more flexibility, low power consumption and range. The data from the WSN can be uploaded to the web based system and can be easily accessed by the users. It helps the medical researchers analyze enough amount of the data from the web servers to limit the asthma spreading and its occurrences based on the indoor and the outdoor air quality conditions. There are five components in this method .sensor, sensor side, WSN server side, data management and graphical user interface.

Sensor Nodes

WSN includes the sensing nodes JN5139-EK030 which comprises of the temperature and the relative humidity sensors. In addition to tat NO_2, O_3 and PM_{10} sensors are used to find out the air quality index of the ambient area [3]. The analog inputs are given to each nodes to get the air quality index of the region. Messages are sent between the wireless network of a 6LoWPAN system as IPv6 packets which are compressed and embedded in IEEE 802.15.4 frames. The received packets are decompressed from the receiver frame.RS232 is used for the packets transmission as illustrated in Fig 2.4

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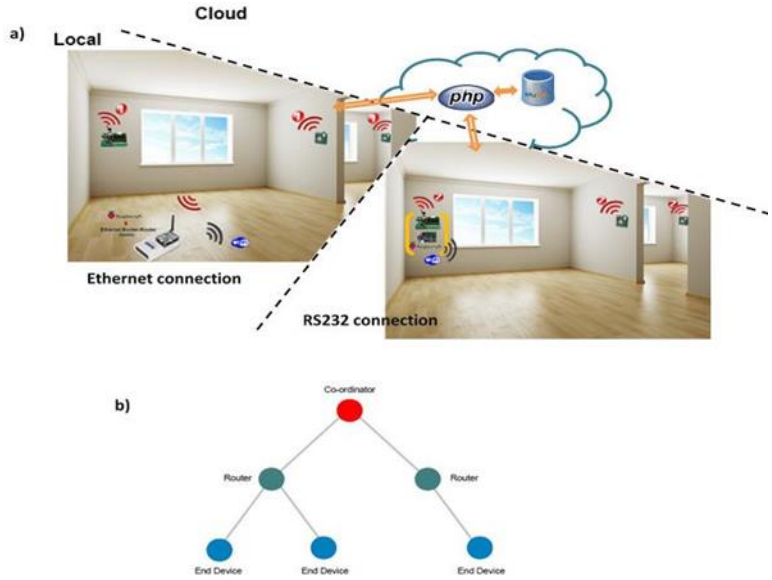

Fig 2.4: a) WSN nodes distribution. b) WSN tree topology [3]

Router and Gateway

The routers are used to route the sensors of air quality and are considered based on the network size. A smart coordinator is used to extend the WSN coverage area to support the big distance between sensing nodes. The top of the network is the coordinator acts as the gateway role in the wireless sensor network. The packets are sent through the Ethernet using the UDP protocol or RS232. The local client of the network is Raspberry Pi computer which runs the java application

Table 1: The sampling rate associated with the concentration measurement of the air compounds

	Index (0h - 23:59h)	
Pollutant	Minimum nr. Samples	Type
NO2	18	hourly average concentrations
SO2	18	hourly average concentrations
O3	18	hourly average concentrations
CO	18	octo hourly average concentrations
PM10	13	hourly average concentrations

System Software

The web service in the software system is based on the client – server architecture. It provides services and security to the system. The service is provided by the java client application. The figure illustrates the design for the indoor and the outdoor networks and build above the client application.

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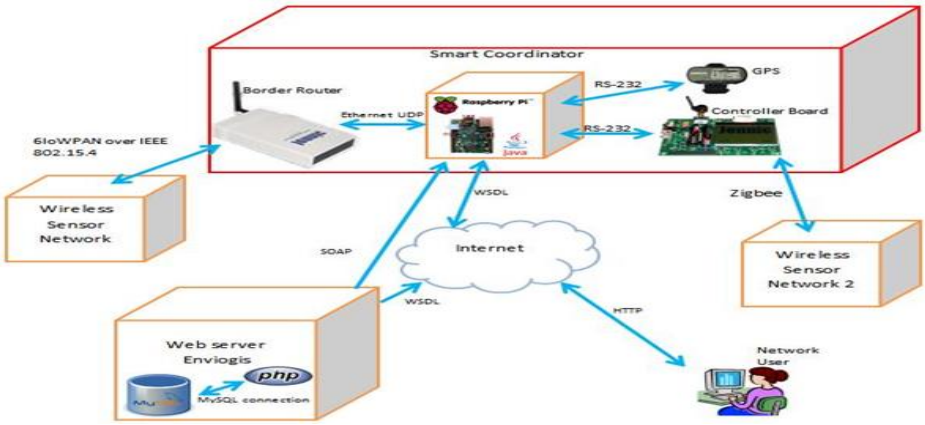

Fig 2.5: Communication and protocols of system [4].

Client Software

The java client application is used to send data to the database and receive data from the coordinator through the UDP protocol or RS232.It provides high response even the client don't have internet connection. In outdoor monitoring it receives the information from the Foretrex 201 navigator. For indoor monitoring the user can find GPS coordinates through the link of the website .In order to make less processing this application is deployed along with the smart coordinator. The sensing nodes process the data and extract the values of the pollutants of the temperature and humidity. Based on the threshold LEDs are used to blink, in case of emergency the alarm goes off.

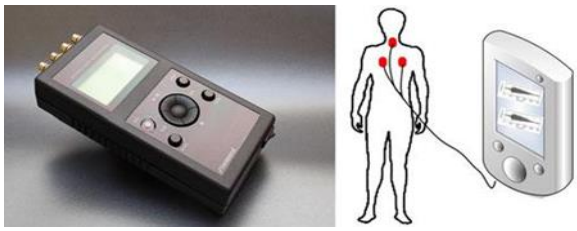

Fig 2.6: Access Network Data in website [5]

E-Asthma Monitoring System

The wheeze detection method illustrated in the Fig 2.7 is developed for the e-asthma monitoring system which is the Future Internet Engineering (Fig2.8).It consist of a four channel wheeze recorder, ARM LPC2468, ARM7 TDMI-S processor, Bluetooth transmitter and a smart phone. Microphone that records the patients breathing is placed on the patient's chest wall. Data is sampled at the frequency of 8 kHz.

Fig 2.7: Prototype of four-channel breath sound recorder [5]

A smartphone has a inbuilt Bluetooth interface to connect it with the device on the patients chest wall.It is also connected with the pulsometer sensor, peak flow meter and wheeze recorder. The datas are continuously sent to the e- system server or on demand. This method ensures high efficiency. Inorder to increase the range extension is offered. The tests are done at home and they aretransferred to external

servers using Wi-Fi or GSM modem.It is thensupervised by a medical doctor during the self tests of the patient.

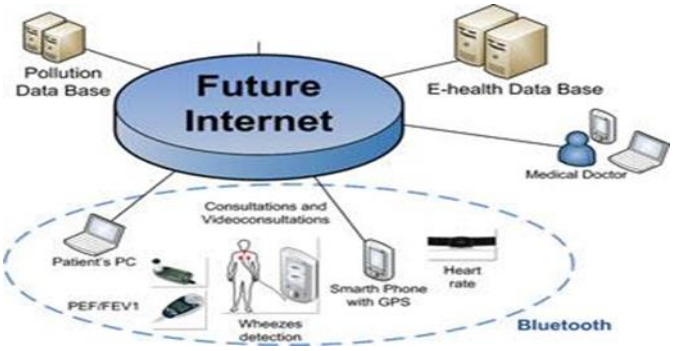

Fig 2.8: Developed E-astma monitoring system. [6]

CONCLUSION

The treatment of asthma involves identification, avoidance of precipitating agents and addition of medication in a step-wise manner using various detection methods. A wireless sensor to monitor the air quality indoor and outdoor is developed with the help of certain trigger factors detection with asthma attacks. A java application bridges between the WSN and the database through internet. As the future enhancement of this technology Sms, Email can be sent to the patient in order to provide more efficient alert monitoring system of the asthma patients.

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