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A Review of Wireless sensor networks System for monitoring of Asthma Trigger Factors

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Abstract: Asthma is one of the widespread chronic diseases. Firstly, the medical background of asthma is given. Pathology and symptoms are presented. Afterwards, the problem of persistent asthma management is introduced with a short overview of traditional disease management techniques. A review on approaches to asthma telemonitoring is made. This paper presents a web information system and a wireless sensor network for indoor or outdoor air quality monitoring with application in asthma trigger factors assessment. Employment of low power wireless sensor networks (WSN) paired with Smartphone technologies is reviewed as a novel asthma management tool. 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. Using the technology, the aim is to retain the disease in a controlled state with minimal effort, invasiveness and cost, and assess patient's condition objectively.

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I. INTRODUCTION

Wireless sensor networks have gained a lot interest in the field of medicine with a wide range of capabilities. In most developed countries wireless sensor networks are being used in monitoring critical illnesses such as Cancer detection, cardiovascular diseases, monitoring asthmatic patient and in the treatment of Diabetes.

A wireless sensor network is a group of specialized transducers with a communications infrastructure for monitoring and recording conditions at diverse locations.

Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions. WSNs were initially designed to facilitate military operations but its application has since been extended to health, traffic, and many other consumer and industrial areas. A WSN consists of anywhere from a few hundreds to thousands of sensor nodes. The sensor node equipment includes a radio transceiver along with an antenna, a microcontroller, an interfacing electronic circuit, and an energy source, usually a battery. The size of the sensor nodes can also range from the size of a shoe box to as small as the size of a grain of dust. 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.

Asthma is the result of constriction of the bronchi and bronchioles, which make the individuals difficult to breathe. Hence, asthma attack narrows the tubes present in the lungs. It is estimated that 300 million people worldwide suffer from asthma. About 10% of overall children population suffers from asthma. By 2025, it is estimated that the number of patients with asthma will grow by more than 100 million. 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 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.

To have an optimal choice of wireless communication protocol it requires performing set preliminary studies regarding the necessities of distributed measurement system and to investigate the solution already proposed in the field. In this case can be mentioned air quality monitoring network based on Wi-Fi or Bluetooth that are relatively low cost solution, with high data rate transfer but high power consumption. In the latest times Bluetooth low energy and ZigBee protocols become the chosen solution for environment monitoring applications. At the same time the ZigBee wireless networks prove to be better succeeded cause by greater flexibility, the lower consumption and the range. Focussing on web based information system that process and publish the data received from air quality WSN the developed system prototype that can be used to help medical researchers to analyse extended amount of experimental data contributing to limit the asthma spreading and asthma attack occurrences based on measurement of the indoor

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and outdoor air quality conditions. Wireless sensor networks have enabled medical doctors to monitor patients remotely and give them timely feedback and support; potentially increasing the reach of health care by making it available anywhere at any time

II. WIRELESS SENSOR NETWORKS

WSN is a group of interconnected node devices that sense and exchange the data gathered from the natural environment, to help reveal and better understand the perceptual properties of the world around us. WSNs allow us to observe and monitor these parameters upfront using electronic hardware and physical sensors. A Wireless sensor networks consists of many spatially distributed autonomous devices, called smart sensor nodes that cooperatively monitor environmental or physical conditions at different locations.

2.1Typical Node And Network Structure

A wireless sensor network smart node has communication capabilities, a processing module with memory, the sensing unit itself, and a power module that allows autonomous operation. The sensing unit may be composed of one or more sensors and an analog to digital converter (ADC).

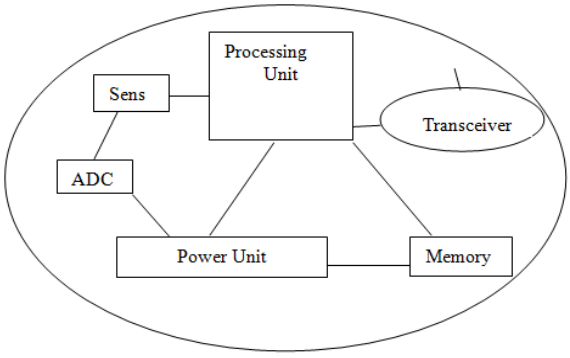

Fig. 1. Basic components of a smart sensor node in a Wireless Sensor Network.

In order to understand the different modules interconnection, figure 1 presents a basic block diagram of the typical wireless sensor network smart node. The size of a sensor node can vary from the size of a shoe-box to the size of a microscopically small particle depending on the specific applications .The cost of a sensor node ranges from hundreds of dollars to a few cents . The size and cost greatly depends on its resources and the sensor itself. This leads to different sensor node's architectures and functionality. A sensor network may have one or more sink nodes (also referred as base station or gateway) that relay data to the outside world. In some rare cases the network can be sinkless, that is, have no sink node.

The sink node(s) receive information from the network and allow data aggregation and consumption.

Figure 2 presents the typical working principle of a wireless sensor network. A Wireless sensor network can be easy to deploy in the desired environment [6] as it requires just the placement of miniature smart sensor nodes, and the information can be gathered, processed and sent to the desired location with the convenience of wireless communication.

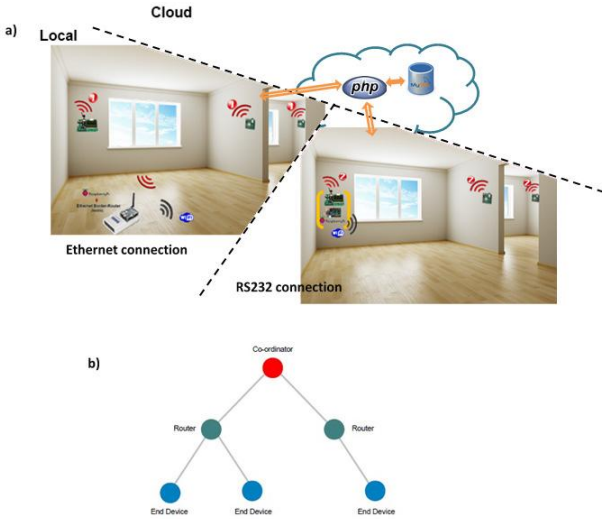

Fig 2. Distributed system for air quality a) indoor distribution of WSN nodes IEEE802.15.4 compatible, b) WSN topology – tree.

In Figure 2 on the left side are represented the border-router connected through the Ethernet port to the embedded PC (Raspberry Pi) working as the smart coordinator, which receives IPv6 frames within IEEE802.15.4 frames and forward them through Wi-Fi to the PHP server. Second smart coordinator architecture expressed by Raspberry Pi and Zigbee coordinator of sensor network is expressed on Figure 2.a right side The first system is based on 6LoWPAN Stack Operation which consists of wired parts (Ethernet bus) and wireless parts (one or more wireless networks).

This architecture is based on the utilization of 6LoWPAN Ethernet Border-Router from Jennic [13], which takes the complexity out of connecting wireless 6LoWPAN to wired IP Ethernet. This aspect was considered important taking into account the existing Ethernet based infrastructure in the air quality monitored areas. For this implementation the IPv6 packets are simply passed from the wired to wireless domains without modification or consideration for any high layer protocol, demonstrating the true scalability of IP that means no additional Gateway characterized by protocol translation to interface into the IP world is needed. For this architecture the WSN coordinator data is accessed by the border router through wireless connection. To increase the flexibility and interoperability of the implemented architecture a smart coordinator based on embedded PC expressed by a Raspberry Pi was considered. The embedded PC assures the hardware support for the client side application, and at the same time provides Wi-Fi Internet connectivity. The embedded PC to WSN ZigBee coordinator communication is based on a RS232 serial communication protocol.

III. LITERATURE SURVEY

Anza(1997) discusses about the use of Holter system for recording cardio activities of cardiovascular patients.

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These systems cannot be used out of hospitals also. These are unable to transmit information automatically to doctors under abnormal conditions.

Jimena Rodfguez(2005) designs the monitoring system that performs a complete ECG analysis near the patient. The steps followed to build ECG beat and rhythm classifier for PDA are given. The results obtains arev shown comparatively better that the previous methods.

Chen (2007) provides a system for continuous monitoring of patients with cardio vascular disease even when these patients are out of hospitals. The system enables immediate response and care for the patient as information is transmitted with the cellular phone. The cellular phone is embedded with the ECG processing algorithms that detect irregular heart rhythm in real time.

Sing-Hui Toh(2008) describes a robust healthcare monitoring and management system with ECG,blood pressure and blood glucose sensors. The architecture supports mobile health care system.

Kho(2005) proposes a wireless patient monitoring system using Bluetooth technology. The work discusses about two lead ECG sensors and transmission of data obtained through Bluetooth wireless link.

Shenoy(2005) proposes a portable telemonitoring system, which captures the ai quality conditions from the school districts using low cost, low power, wearable electronics to a workstation or a portable computer. The aim of the author is to store the readings ontained from the sensors,process the information,and raise an alarm if quantity of asthma triggers rises beyond the considered safety zone.

IV. TRADITIONAL PROCEDURES OF ASTHMA MANAGEMENT

Recurrence of the asthmatic attacks leads to irreversible advancement of the disease into the subsequent stage. The goal of daily management of asthma is retaining the disease in the diagnosed stage and prevention of further progression. Thus, it is necessary to ensure long-term adherence of the patient to the chronic disease management plan. Traditional procedures of asthma management in most cases consist of adherence to the intake plan of prescribed medication including both preventive and emergency medication, avoidance of diagnosed triggers in the environment, periodical pulmonary function self-assessment and periodical check at the medical specialist for evaluation of the level of control Paper written asthma diaries of types and times of occurrence of the symptoms and amounts of medication taken are the traditional way of patient monitoring, common to chronic diseases in general. Due to patient's and medical specialist's overhead, such diaries are commonly practised only on limited groups, for a limited time during clinical studies. In combination with diaries, simplest mechanic peak flow meter devices (PFM) are issued for management at home, for self-assessment of severity of airflow obstruction. They are simplified version of ambulatory spirometers for home use. Featuring limited accuracy, they are able to estimate a limited set of spirometric parameters: PEF (peak expiratory flow [L=s]) and FEV-1 (forced expiratory volume of the air exhaled in the first second [L]). Best value is always taken as a final result of particular measurement session. Measurements are typically conducted in the morning and in the evening to show diurnal variability between measurements. Results of the measurement in the morning are usually worse, and often reflect night symptoms (nocturnal asthma). Results are typically divided into simple colored zones to simplify interpretation - e.g. red, yellow and green typically resembling 80-100%, 60-79% and <60% of full scale respectively [6]. With the goal of reducing asthma management overhead of all groups involved (patient, caregiver, health insurance), approaches to telemonitoring systems for asthma management are presented in next section.

V. PROPOSED SYSTEM

Most of the worked carried out in the area of the WSN using different sensors with the use of different wireless devices like Zigbee, Bluetooth ,RF & many more. But no one has used the methodology as the Wifi or the Ethernet network for measuring this parameters & send on the Web Browser.

Many author they had user the PIC,ARM 7 ,8051 as main Microcontroller for this system Design. But all are getting problem in the Ethernet or Wi-Fi network if they want to send data on web. Proposed system based on the design of WSN for the measuring the Environmental parameters like Temperature, Humidity & Carbon dioxide contains. This parameter sends on the Web Browser by using the Wi-Fi or Ethernet network. Main controller of the System is ARM 11 Raspberry Pi with the operating frequency of 700MHZ.

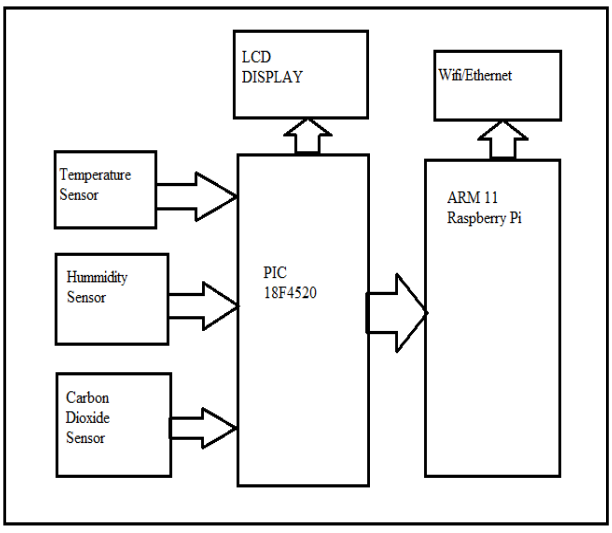

Fig. Block Diagram

VI. FUTURE SCOPE

- Future scope of the system is it would be possible to maintain the Database for the system .

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- Design of Data Logger like system which store the parameter on the SD card or Hard Drive for future reference.

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