International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 4 Volume No.8 July - August – 2024
DOI:10.46647/ijetms.2024.v08i04.022 ISSN: 2581-4621

DESIGN AND STUDY OF FOIL BASED ROBUST WHEEZING MONITORING SYSTEM FOR ASTHMA PREVENTION

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Abstract

Nowadays, many people were suffered by wheezing due to their health issues and environmental problems. This causes them to become an Asthma patient in future. Hence, this paper presents a flexible system designed to monitor and detect the wheezing problems while attached to the diaphragm of the human body. The sensor is designed to resonate the frequency range of wheezing as 100-1000 HZ. This system is designed by low-cost sustainable aluminium foil which acts as the sensor to sense the following things: 1. Temperature 2. Pressure 3. Sweating 4. Shivering. The aluminium foil acts as a two-way benefit system. First, it acts as the amplifier to detect the resonance of diaphragm. Second, it acts as the low-pass filter to reduce the background noise. This lies greater than 1000 HZ. Also, this system consumes low power and less space. This smart system is combined with the matched filter algorithm to form a robust-wheezing monitoring system. This system can detect wheezing by sensing and analyzing the respiratory features. The device interfaced with the Bluetooth-enabled chip or Smartphone. This further identifies the patient who having this system is suffered by Asthma or not with the integration of Internet of Things (IOT).

Keyword: Flexible, Foil based, Robust Wheezing system, Resonates, healthcare, Low Cost, wheezing, Wireless.

I. INTRODUCTION

Wheezing is a common clinical symptom in patients with obstructive pulmonary diseases such as chronic bronchitis, and bronchial asthma. Automatic wheezing detection system offers an objective and accurate means for identifying wheezing from the symptoms of whistling sound and laboured breathing, particularly when exhaling; sometimes they're accompanied by a feeling of tightening in the chest. Abnormal lung sounds, helping physicians in the diagnosis, long-term auscultation, and analysis of a patient with obstructive pulmonary disease. This paper describes the design of a fast and high-performance robust wheezing monitoring and recognition system. A wheezing detection algorithm based on the matched filter algorithm is proposed. This can be detected by looking up the frequency ranges from 20 Hz-20000 Hz. Experimental results of a qualitative analysis of wheeze recognition monitor and showed a high range of frequency identified as over 20000 Hz and intimates to the health care system to take care of the patient who connects their health records to the healthcare system via Bluetooth devices or some other mobile systems. The low cost sensor allows for integration at large scale in the real-time monitoring of patients that are at risk who became an asthmatic. This system further allows the internet-of Things (IoT) enabled systems for detecting the asthmatic patients very simply and easily manner.

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II. RELATED WORK

A. LITERATURE SURVEY

The number of patients suffering from a respiratory disease such as asthma is on the rise, with an estimated 334 million individuals affected as of 2014 [2]. A patient is diagnosed with active asthma if three or more wheezing episodes occur in a year [3]. An asthma detection and monitoring study concluded that an early diagnosis of asthma is possible using noninvasive techniques by observing the airway resistance in the trachea [4]. This airway resistance produces wheezing sounds. Wheezing traverses through any medium by the fluctuation of pressure. Thus, wheezing can be detected by a pressure sensor.

Electrocardiography (ECG) is a widely used method for wearable health monitoring and wheezing detection, but the data acquisition process is complicated. The ECG sensors need complex signal conditioning circuits to convert the raw data into something meaningful, which reduces their feasibility as wearable monitors; large PCB (Printed Circuit Board) boards using several ICs (Integrated Circuits) are required to process the signal from the sensor before it can be read by a microprocessor. Even with complex electronic interfaces, the ECG signals are still prone to motion and muscle artifacts [5].

Microphones have proven to be the most practical solution to acquire sounds from the neck or chest [6, 7]. Microphones are small to reduce the high costs of the silicon-processing equipment and the silicon material itself, causing the sensors to have a very high resonance frequency (in the kHz range) and very small output signals [8]. Thus, they require complex signal amplification circuits, which introduce additional noise that must be reduced by additional signal conditioning circuits [9, 10]. This compromise of using a higher resonance frequency diaphragm is made so that it can respond to a larger frequency range, which is desirable for microphones as they are intended for sensing human speech. However, when we need a limited frequency range, as in the case of detecting wheezing (100- 1000Hz), a larger diaphragm with lower resonance frequency is desirable in order to get maximum signal to noise ratio.

A low-cost, flexible wheezing sensor made from aluminum foil using DIY (Do-it-Yourself) techniques [10]. Its resonance frequency resides in the wheezing frequency range; thus, the diaphragm of the sensor achieves a sizable deflection, creating a large output signal without amplification circuitry. The sensor is directly connected to a micro controller, which is trained to detect several kinds of wheezing (monophonic and polyphonic) using templates of different wheezing sounds acquired from asthmatic patients. The flexibility of our sensor allows it to be packed in a flexible Styrofoam packaging and adhered to the chest of a subject with minimal intrusion as an add-on. When detecting wheezing, other chest sounds like coughing, breathing, and talking are considered as noise. Therefore, we imitated a real-life scenario to demonstrate how wheezing can be detected by our sensor in real time from the human chest using signal processing. We recorded several chest sounds using our sensor and superimposed them on wheezing sounds to create a noisy signal. Matched filtering was then used to detect the wheezing sounds in the noisy signal.

B .IoT METHODOLOGY

The Internet of Things (IoT) technology is becoming increasingly common in the healthcare industry. The primary applications of IoT in the field of intelligent medicine include the visualization of material management, digitization of medical information, and digitization of the medical processes. The rise of IoT is exciting for everybody due to its different scope of use in

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various sectors. In healthcare it has several applications. IoT in healthcare helps in: i) Reducing emergency room wait time, ii) Tracking patients, staff, and inventory, iii) Enhancing drug management and iv) Ensuring availability of critical hardware.

FIGURE.1 **IoT on Medical Field**

IoT has also introduced several wearables & devices which has made lives of patients comfortable.

III. EXISTING METHODOLOGIES

In Today's tautness life people are facing multiple physical, physiological, psychological problems. They have no time to visit doctors again and again. Sometimes there is a situation when a patient requires treatment on the spot. As healthcare costs are increasing and the world population is ageing, there has been a need to monitor a patient's health status while he is out of the hospital in his personal environment. The heart Diseases cause millions of deaths worldwide because of the increase in the aging population and the rising of healthcare costs. There is also a demand of quality healthcare from remote locations.

IV. PROPOSED FRAMEWORK

In this project, medical sensors were used to collect physiological data from patients and transmit it to Intelligent Personal digital Assistant (IPDA). This project explains the important role of body sensor networks in medicine to minimize the need for caregivers and help the chronically ill and elderly people live an independent life, besides providing people with quality care. Although offering significant benefits, the field of wearable and implantable body sensor networks still faces major challenges and open research problems which are investigated and covered, along with some proposed solutions. The system enables doctors to remotely follow-up the status of their patient using their computer and smart phones. The system was tested and checked by medical team for validation.

V. WORKING METHODOLOGIES

A. HEALTHCARE SYSTEM

Healthcare systems are a very important part of the economy of any country and for the public health. In smart patient management monitoring and tracking system, the system will create unique identification numbers for each patient which will identify her/him in the health information system. This ID is then linked to all recordings of the patient's vital signs and saved in a database for further analysis and historical consultation. The system will also provide real-time patient monitoring of vital signs during their stay in an emergency and critical care unit in a hospital.

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FIGURE.2 Healthcare System

It also alerts hospital staff if any abnormality is detected. When the biomedical data of any patient tends to be abnormal the unique ID of the patient will give away all the information and medical history of that patient and the patient will be treated as per requirements and biomedical condition of the patient will get registered on the unique ID of the same patient. Patient information will be retrieved from the database using this ID.

B. MEDICAL DIAGNOSIS

Such an automated system for medical diagnosis would enhance timely medical care followed by proper subsequent treatment thereby resulting in significant lifesaving. Incorporating the techniques of classification in these intelligent systems achieve at accurate diagnosis.

FIGURE.3 Medical Diagnosis

Neural Networks has emerged as an important method of classification. With patients attached to vital signs and information, problems could be more rapidly diagnosed, a better quality of care can be given, and resources can be used more efficiently.

C. HANDHELD DEVICE

The temperature sensor responds to relative changes in light intensity. This is due to the reflected light intensity being affected by the flow of blood through our body.

FIGURE.4 Hand-held Device

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As the heart pumps blood through the body with every beat, there is a pulse wave that travels along all arteries to the very extremities of capillary tissue. A rapid upward rise in signal value occurs as the pulse wave passes under the sensor, then the signal falls back down toward the normal point.

D. LOCATION BASED MEDICAL ASSISTANCE SYSTEM

The given system uses Open Street Map (OSM) to locate where the healthcare centers are mapped taking the waypoints of them. The system is given a name as Location Based Medical Assistance (LBMA) which is integrated with afore mentioned OSM for the operation and location analysis of the emergency service. Open Street Map is for all the users of world. The Open Street Map Foundation (OSMF) is an international not-for-profit organization supporting but not controlling the OSM project.

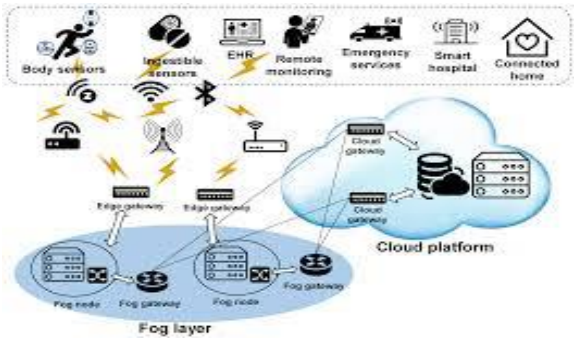

FIGURE.5 Location Based Medical Assistance System

To further reduce the time delay between the incident and the treatment received by the patient for the cause the use of location co-ordinates of the patient prove to be of good use as the nearby emergency services like ambulance service or hospital service can respond immediately to the location of the patient.

E. FALSE ALARM

A button is incorporated on to the wearable headset which acts as a false alarm button. In case one or more of the sensors malfunction and start generating garbage values that surpass the scope of the uploaded program, a buzzer will go off indicating the malfunction.

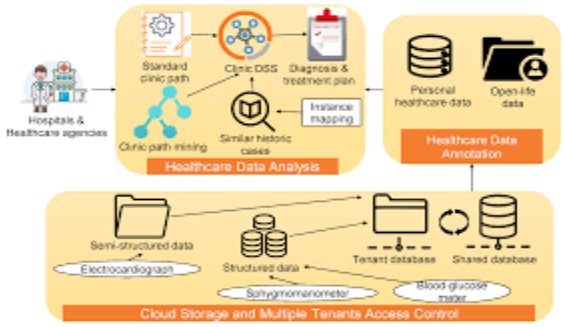

FIGURE.6 False Alarm

Since the user will be under normal circumstances, he/she can turn off the signal and preventing any notification to the predefined contacts, thus avoiding a false alarm.

VI. CONCLUSION

IoT changes the way the facilities are delivered to the healthcare industry. These technologies improve the product, causing a larger effect by bringing together minor changes. The integrated sensors are genuinely a modern-science machines such as Bluetooth-enabled devices and mobiles. These are minimum-sized sensors which monitor the medication in our body and warn us if it detects any irregularities in our bodies. These sensors can be a boon for a wheezing or asthmatic patient as it would help in curbing symptoms and provide with an early warning for diseases. IoT devices can reduce much manual work which a doctor has to do during patient charting. It is

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powered by voice commands and captures the patient's data. It makes the patient's data readily accessible for review.

VII. FUTURE SCOPE

Most of the peoples are often neglected and helpless in times of medical emergencies, when they are alone in their twilight years. To meet the need have come up with a prospective Remote Health Monitoring and Alert System (RHMAS). Usually heart attacks are coupled with the symptoms of body temperature fluctuations, high Blood pressure, profuse sweating, improper cardiac rhythm etc. Our solution is to assimilate robust sensors capable of sensing and monitoring those symptoms with a microcontroller to alert their condition of health to the nearest and dearest people during emergencies. Since most devices for this purpose are wired, a wireless device wouldn't hinder the movement of the user. In case if the monitored data attains the level of emergency, the senior citizens would be given proper health services.

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DOI:10.46647/ijetms.2024.v08i04.022 ISSN: 2581-4621

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