Design and Implementation of Digital Asthma Diagnosis System

Qinghua Yao, Changchun University of Technology, Changchun, China
Xiantao Yang, Changchun University of Technology, Changchun, China

ABSTRACT
In this article, the MSP430F149 is the microcontroller (MCU), and a pressure sensor, MPX5100AP, is used to measure body measurement of maximal forced expiratory volume (FEV) and peak expiratory flow rate (PEFR). The two analog signals are processed by the signal conditioning circuit, and then the corresponding digital signals are acquired by the MCU. With the related operations of multiple respiratory parameters, a built-up time of respiration signal mutation rate values and the determination of the mutation rate, a mathematical model is built among FEV, PEFR and the rate of variation. The mathematical model of the system is analyzed, and the relationship between the detection results and the degree of airway obstruction is established. Finally, the patient’s condition analysis results are given directly on the LCD, which provided the objective indicators for the medical treatment of the disease.

KEYWORDS
Asthma, Diagnosis, FEV, Mutation Rate, PEFR

1. INTRODUCTION
Asthma is a common chronic airway inflammatory disease, morbidity and mortality have been showing an upward trend, which will threaten the lives of people (Pocket, 2011). It has become a common disease affecting public health, but the commitment pathogenesis of asthma is not clear at present. There is no specific treatment approach for commitment disease, and the early prevention and treatment of asthma is very important (Masoli,2004). Adhere to long-term regular treatment can get good control of asthma symptoms as long as the timely and correct diagnosis, which will reduce the recurrence even longer episodes. PEFR and FEV are important indicators of bronchial asthma diagnosis and detection, then they can be based on the size of the PEFR and FEV values to determine the diameter of the airway and infer the incidence of asthma (Ma, 2009). Currently, the peak flow meter is only the completion of the PEFR and FEV detection and display on the market, and the instrument shall be under the guidance of a doctor. If asthma patients do not understand the mechanism, it cannot be used directly to learn prevalence.

2. DEVELOPMENT STATUS AND TRENDS
The basic lung function test instrument used in large hospitals is the lung function tester, which can detect and diagnose asthma. The microcomputer processing system is used in the pulmonary

DOI: 10.4018/IJHISI.2019070101

Copyright © 2019, IGI Global. Copying or distributing in print or electronic forms without written permission of IGI Global is prohibited.
function test instrument to measure the expiratory and aspiratory functions of the human body by a breathing flow sensor. After its analysis and processing, the results are displayed by a liquid crystal display (LCD) and printed by a graphic printer. But this kind of instrument is expensive, bulky and inconvenient to carry. And it is more troublesome to repair, not suitable for rural small hospital, and more unsuitable for family care use.

At present, the domestic development of asthma diagnosis instrument is basically asthma traditional detector with mechanical pointer, and the detector is provided with red, yellow and green signs. When it works, the mechanical pointer points to the different areas, by which a doctor can determine the degree of airway obstruction. The clinical application is less.

The American blue head asthma detector is also a traditional mechanical pointer. The results of measurement are not intuitive, so it needs to be used with the guidance of doctors. It is not suitable for family monitoring. The Japanese developed model SH238PK-8 and the United States developed asthma diagnostic apparatus SH238PK-8 can measure maximum forced expiratory flow (PEFR) and forced expiratory volume in one second (FEV) simultaneously, which can help doctors objectively evaluate the grade of asthma and the effect of drugs from qualitative to quantitative. But the people who don’t know the mechanism of asthma, don’t diagnose illness from the PEFR and FEV value, so it is also not suitable for family.

At present, the asthma detector on the market just finished the examination and display of expiratory flow and forced expiratory volume. Asthma patients who don’t know the mechanism, can’t be directly to understand their prevalence, and this kind of apparatus should be used with the guidance of a doctor. So the development of new asthma diagnosis instrument meets the needs of the industry and market.

3. PRINCIPLE OF FLOW VELOCITY MEASUREMENT

At present, a widely accepted theory of gas flow measurement is to calculate the gas flow rate by comparing the delay difference between the two separated sensors and the distance between the two sensors (Wang, 2014). Through the character of gas flow sensor to capture the signal about the nature of the obtained material, the gas velocity signal is received. After acquiring sensors’ signals, the signal of the corresponding back-end processing is to realize the measurement of gas flow rate. The related detection signal method of correlation coefficient is selected, which is shown in Figure 1. The basic idea of related measurement technique is to convert the flow velocity measurement to the time interval measurement by the analysis of the flow noise signal, and the gas flow rate is measured by the distance between the two sensors (Gretchen, 2002).

In the vertical flow along the pipeline, L distance, is installed in the same structure downstream of the sensor. Fluid inside of the random noise and the characteristics of gas sensor generate a random modulation, and the output of the sensor will correspond with change with the modulation effect and so on. Downstream of the sensor output, \( x(t) \) and \( y(t) \) is with the measured gas flow on the flow noise signal (Mandal, 2006). The gas flows from upstream to downstream sensor for transit time. \( x(t) \) and \( y(t) \) cross-correlation function \( R_{xy}(\tau) \):

\[
R_{xy}(\tau) = \lim_{\tau \to \infty} \int_0^\tau x(t)y(t+\tau)dt
\]  
(3.1)

When \( \tau = \tau_0 \), \( R_{xy}(\tau) \) gets the maximum value. \( x(t) \) and \( y(t) \) cross-correlation function, corresponding to the peak \( \tau \) value, is fluid flowing through the upstream to downstream sensor and the transit time is \( \tau_0 \). The given tracheal area and gas pressure are reused, which can calculate correlation velocity.
Innovative Architecture to Enhance Quality of Service for Laboratory Management Information Systems
www.igi-global.com/chapter/innovative-architecture-to-enhance-quality-of-service-for-laboratory-management-information-systems/115615?camid=4v1a

Political Attitudes on the Dutch Electronic Patient Record
www.igi-global.com/article/political-attitudes-on-the-dutch-electronic-patient-record/120115?camid=4v1a