A Wireless Smartphone-Based System for Diagnosis of Pulmonary Illnesses

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The prevalence of respiratory illnesses such as Asthma and COPD (Chronic Obstructive Pulmonary Disease) has been growing rapidly across the world. The spirometry equipment used in hospitals for pulmonary function testing costs thousands of dollars. In this project, my objective is to design a smartphone-based low-cost full-function pulmonary function analyzer that can be used to measure lung function and diagnose various respiratory illnesses. I have successfully developed a prototype of the pulmonary function analyzer and completed extensive testing of the system. The mechanical part of my system consists of a 3D-printed spirometer shell. The instantaneous flow rate during breathing is measured by a pressure sensor as air passes through a fine wire mesh in the shell. The pressure sensor output is sampled by a microcontroller, which transmits the information over a Bluetooth 4.0 link. The measurement data is received by an Android app running on a smartphone or tablet, which analyzes the data and displays it graphically. The app computes various quantitative metrics of the lung performance and compares them to their predicted values based on the user's age, gender, etc. Based on these comparisons, the app determines the probabilities of the results matching the characteristics of five different respiratory diseases: COPD, Asthma, Emphysema, Chronic Bronchitis and Restrictive Lung Disease. I used the IngMar Medical ASL 5000 breathing simulator to validate my system, by simulating the breathing patterns symptomatic of various diseases. The results show that my system classifies the air flow patterns resulting from the five different diseases and makes inferences correctly. The total cost of parts of my design is $35, allowing it to be sold commercially for under $50.

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