UNIVERSITI TEKNOLOGI MARA

BREATH SENSOR CHARACTERIZATION IN PATIENTS DISEASES – CONTROLLED CONDITION

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ABSTRACT

During human breathing, the inhalation and exhalation processes are involved. Most research in human breath analysis focuses on both the bulk matrix and breathing pattern. The conventional way of diagnosing the diseases usually took longer time with painful procedures. Different types of diseases can be characterized by abnormal breathing patterns. The purpose of this thesis is to investigate a breath sensor device capable of detecting moisture in the human bulk matrix in both indoor and outdoor conditions. In this way, breathing patterns can be captured. In this study, COMSOL Multiphysics is used to simulate the breath sensor. A breath sensor is simulated with the MEMS module and tested in specific environments with COMSOL Multiphysics to see breath sensor performance. In addition, the breath sensor device was tested indoors and outdoors at a variety of input wave frequencies. The breath sensor device was developed by Noriah Yusoff in previous study. The frequency generator is connected to the breath sensor to give the input waveform and an oscilloscope is used to capture the output reading of the breath sensor. Breath sensor activation requires one exhaled breath from a human subject. This method is more straightforward, and the oscilloscope generates the output wave results in real-time. Research shows that the sensor can operate indoors and outdoors within 1.5 seconds of response time. This indicates that the breath sensor can capture human breathing. Furthermore, the sensor's sensitivity exceeds the baseline reference of 10mV, so it is sensitive enough to detect moisture in human breath regardless of the conditions under which it operates. 16 healthy diabetic patients were involved in this study, while 6 unhealthy diabetic patients were included. Throughout the study, the breath sensor was able to detect moisture in human breath and perform as expected. These results suggest that the investigated breath sensor can be used for clinical and healthcare monitoring.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Breathing is a crucial physiological activity for each human being to remain alive. In any human being, the ability to breathe normally is automatically regulated by the neuronal activity of the brain [1]. As such, a complete normal breathing process involves the rest period inhalation and exhalation as shown in Figure 1.1. The rest period is known as the transition time before the next inhalation and exhalation start.

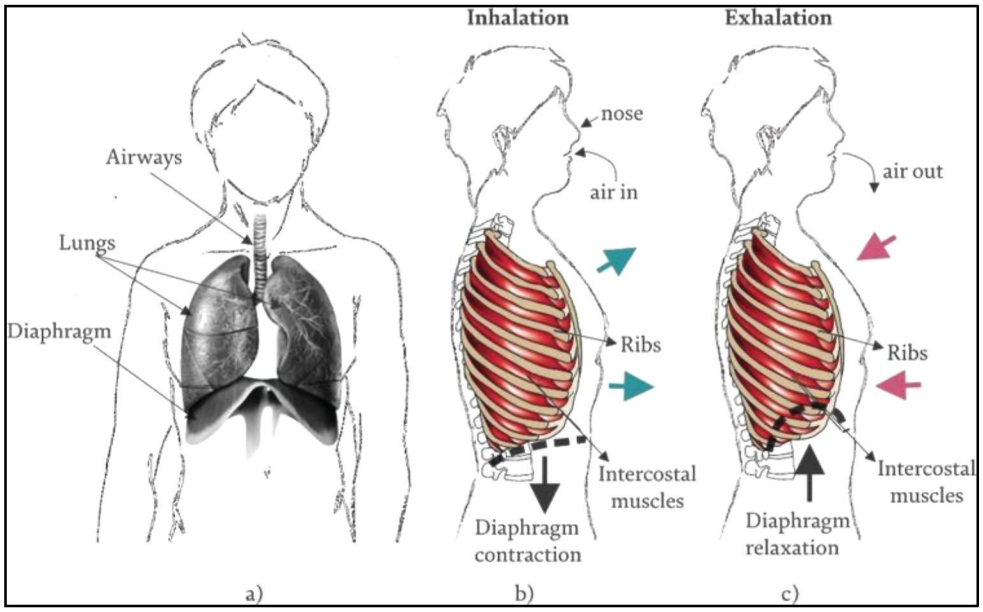

Figure 1.1 Inhalation and Exhalation Process [2]

Then, breathing is a part of respiration that involves inhaling air from the atmosphere and then exhaling that used air which contains a combination of oxygen (O_2), carbon dioxide (CO_2), nitrogen(N_2), water vapor (H_2O), other traces inert gases, and a small amount of volatile organic compounds (VOCs) [3]. Thus, the composition of air in exhalation remains almost the same as the air composition in inhalation, except for the percentage of carbon dioxide and oxygen as shown in Table 1.1. This is because human cells generate energy by using oxygen from inhaled air and produce carbon dioxide as a by-product. Various studies indicate that the bulk matrix of the breathing mixture varies