SUMMARY OF Ph.D. DISSERTATION

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Title

A Development of an Automatic Analyzing Algorithm for Diagnosing Sleep Disordered Breathing Utilizing Non-contact Respiratory Movement Monitoring System

Abstract

Sleep disordered breathing (SDB) is a dangerous disease which increase risk of apoplexy and high blood pressure besides the danger of driving vehicles and daytime performance deterioration by excessive sleepiness. This is the reason why it is desirable to prepare the condition in which people are able to utilize inspections for SDB easily. Although the demand of inspection of SDB increases as it gets popular, overnight polysomnography (PSG) inspection, which is the golden standard for SDB diagnosis, costs high and the equipments and specialists are not enough so far.

In this study, aiming to provide a screening apparatus that is accurate and easy to use, an algorithm, which generates information to determine type of SDB and severity of the disease by analyzing the data obtained by the non-contact and non-restrictive respiratory movement monitoring system that is originated in our laboratory, has been developed.

In Chapter 1, the background and the purpose of this study are explained.

In Chapter 2, the points of SDB are stated to make the important matter for developing the algorithm clear.

In Chapter 3, the basic theory of the FG respiratory movement monitoring system (FGRM), which acquires the respiratory movement data, is described. An improved point to suit the system to the purpose of this study is explained and it is pointed out that the system must be adaptive to the sensitivity change by the position change of the examinee's body.

Chapter 4 describes the method to create the SDB diagnosis data. It consists of two major subalgorithms. One calculates the position of the boundary of chest and abdomen using light spots movement data acquired by the FGRM. It also creates respiratory movement signals of each of the chest and the abdomen respectively. In the subalgorithm, the boundary is calculated using the center of the gravity of the light spots regarding the distance of movement of each of them as weight. The other subalgorithm detects disordered breathing events in the signals and classifies them to three types of apnea and hypopnea. At first, baseline to evaluate the reduction of the breathing is calculated and the events are detected. Then, the types of the detected events are discriminated using the crosscorrelation function of the signals of the chest and the abdomen and autocorrelation function of each of them.

Chapter 5 shows experimental results one of which indicates a high correlation coefficient of 0.90 in a correlation analysis of the apnea hypopnea index (AHI) between PSG inspection data and our system's. At this experiment, the light spots data of the FGRM and the PSG inspection data are acquired simultaneously at the School of Medicine, Keio University. Then, the respiratory movement signals of the chest and the abdomen are calculated and the disordered breathing events are detected and classified by the algorithm described above.

In Chapter 6, it is suggested that the developed system is useful and competitive for SDB screening by the investigation of the results of the experiment.

Chapter 7 summarizes the result of the study mentioning the merit and applicability of the system.