SUMMARY OF Ph.D. DISSERTATION

School	Student Identification Number	SURNAME, First name
Integrated Design Engineering		AOKI, Hirooki

Title

Development of Non-contact Respiration Monitoring System for Sleeping Person Using Near-infrared Irradiation of Bright Spots Matrix

Abstract

The action of the respiration reflects the personal health status, and is the important vital sign revealing " quality of the sleep". So, it is resumed that the respiration monitoring while sleeping seems to have the social significance. The author developed the non-contact and non-restraint sleep respiration monitoring system adopted the method of the irradiation of the near-infrared bright spots matrix, aiming at the safety and simple realization of the all-night respiration monitoring

In chapter 1, the author summarizes the social background and previous studies.

In chapter 2, the author describes the principle of the respiration monitoring by the bright spots matrix irradiation and the configuration of the respiration monitoring system. In the developed system, the fiber grating vision sensor known as an active type high-speed three-dimensional sensor was applied to satisfy the non-contact and non-restraint respiration monitoring. The fiber grating vision sensor is composed of a bright spots matrix projector and a CCD camera, and these are placed above the sleeping person oriented in a lengthwise direction of the bed. And the bright spots matrix projector projects the matrix pattern of multiple bright spots on the body surface of sleeping person.

In chapter 3, the algorithm of the monitoring and the analysis of the respiration status of the sleeping person is proposed. In the proposed algorithm, the inter-frame shift quantities of the bright spots that accompany the abdomen and the thorax movement during the respiration are tracked. And, the respiratory waveform is obtained after integrating the inter-frame shift quantities for the coordinates of the all bright spots on the image. The movement of the bright spot in the image is correspondent to the height variation of the projection point. Therefore, the respiratory waveform seems to reflect the total movement of abdomen and thorax, that is, the respiratory movement quantity. The respiratory waveform includes the respiration rate, changes in the ventilation, and the body movement interval, and these values enable us the investigation of the transition of the respiratory condition throughout the night.

In chapter 4, the result of the preliminary experiment performed to verify the effectiveness of developed system is described. As results of preliminary experiment through the simultaneous measurements with the developed system and an orifice meter and a spirometer, it is confirmed that respiratory waveforms obtained by this system reflect the changes of volume occurring with respiratory movement of examinee. Also simultaneous measurements with this system and a simplified polysomnographic device indicated that this system is equivalently operable with the conventional technique in respect of the sleep respiration monitoring over night. Additionally, in chapter 4 the author describes the results of all-night monitoring study performed as a field test in order to investigate the actual condition of sleep of elderly people in health care facilities for elderly people. As a result of the field test, most of these elderly people exhibited the sleep disorder. And the reality that sleep disorder of elderly people is largely influenced by the sleep disordered breathing such as sleep apnea syndrome is confirmed.

Chapter 5 describes the effectiveness and the accuracy of non-contact and non-restraint respiration monitoring using our system. And, the rest of problems in the respiration monitoring by this system is discussed in this chapter.

Chapter 6 summarizes the results of this study.