HIROSHIMA INSTITUTE OF TECHNOKOGY

A MICROCOMPUTER-BASED RESPIRATORY AND ACTIVITY RECORDING SYSTEM

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INTRODUCTION

Numerous types of human activity recording systems have been developed for measuring the duration and timing of sleep/wake conditions. These systems are limited by recording only general activity. However, it is important to simultaneously record both activity and physiological parameters, such as respiration. This microcomputer-based respiratory and activity recording system is capable of detecting a life-threatening physical condition, such as stroke or cardiac/respiratory arrest.

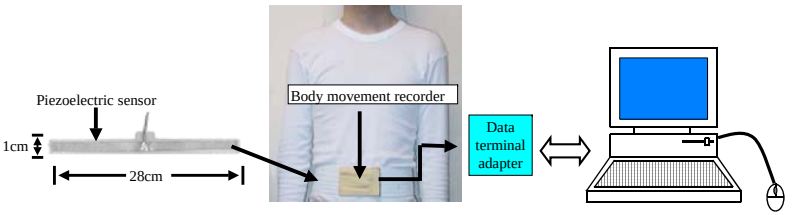

Figure 1 The microcomputer-based respiratory and activity recording system, which consists of a piezoelectric sensor (Pennwalt, Kynar Piezo Film), a body movement recorder, a data terminal adapter and a personal computer. The piezoelectric sensor, attached to the inside of the waist belt, detects the movements produced by respiration, heart pulse, walking and running. The recorder stores the body movements.

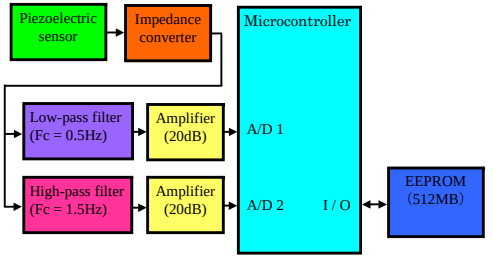

Figure 2 The body movement recorder block diagram. The recorder employs the piezoelectric sensor, an impedance converter, two low-power active filters, two low-power amplifiers, and a low-power 8-bit single chip microcontroller (Micro chip Technology, PIC16LC711). The A/D1 converter for the respiration samples the amplified low frequency components at 4Hz and stored to the EEPROM. The A/D2 converter samples the amplified high frequency components at 40Hz. The activity is obtained by adding the sampled data for 1 second and stored to the EEPROM.

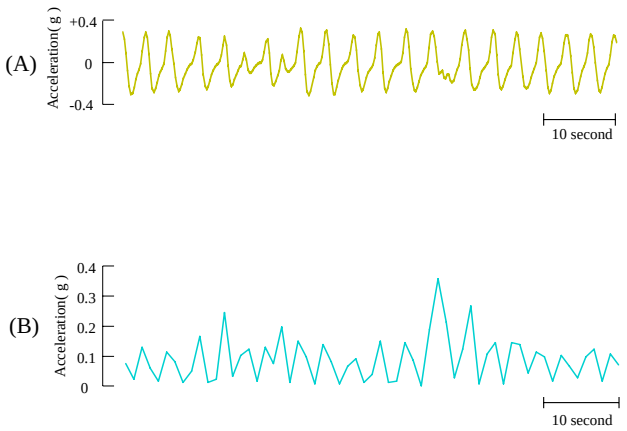

Figure 3 Typical respiration (plot A) and activity (plot B) recorded by the system. The 0.5 Hz low-pass filter detects the major respiratory component of slow body movements. The 1.5Hz high-pass filter detects the high frequency components produced by the heart pulse, walking and running. The activity is obtained by adding the sampled data for 1 second.

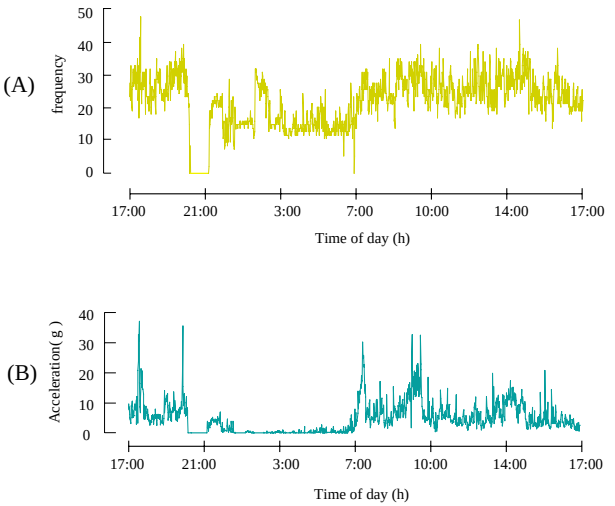

Figure 4 The mean respiration (plot A) and activity (plot B) of successive 1 minute periods for 24 hour. The frequency of respiration was approximately 20-30 in awake condition, and the frequency in sleep decreases to 10-20. Whether the patient is resting or moving can be detected from the activity level. These results indicate that the frequency of respiration and activity closely influenced each other.

CONCLUSION

The developed system employs the thin piezoelectric sensor, which can record the body movements. The high and low frequency components from the recorded body movements are discriminated by high and low pass filters. The high frequency components reflect the body movements produced by cardiac vibrations, walking and running activities. The low frequency components are mainly generated by respiration.

The subject's general health condition and living patterns, as well as the effects of many immediate physiological and psychological conditions, may be obtained from these respiration and activity data.

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