A SYSTEM FOR MONITORING HEART PULSE, RESPIRATION AND POSTURE IN BED

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INTRODUCTION

For general evaluation of the physical condition of in-bed hospitalized patients and elderly people who need constant care, it is very important to monitor physiological parameters such as heart pulse, respiration and also body position. Numerous types of awareness recording systems have been developed for measuring the physiological parameters or posture in bed; however, these systems can not simultaneously record both physiological parameters and posture. The monitoring system in this study consists of piezoelectric film acceleration and pressure sensors for measurement of heart pulse, respiration and posture.
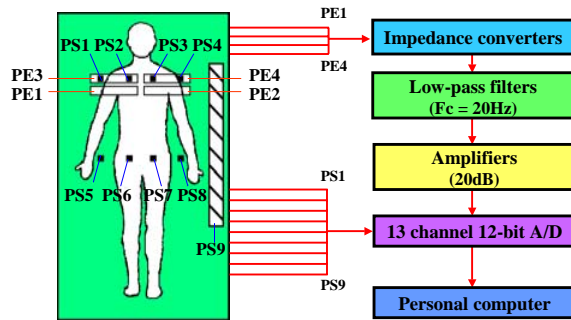

Figure 1 The non-invasive monitoring system of heart pulse, respiration and posture in bed. The system consists of four 2 cm x 28 cm x 28 μ m piezoelectric film acceleration sensors (PE1-PE4), eight 2 x 2 x 0.3 cm small pressure sensors (PS1-PS8), a 5 x 100 x 0.3 cm long pressure sensor (PS9), four impedance converters, four 20 Hz low-pass filters, four 20 dB gain amplifiers, a 13 channel 12-bit A/D converter and a personal computer.
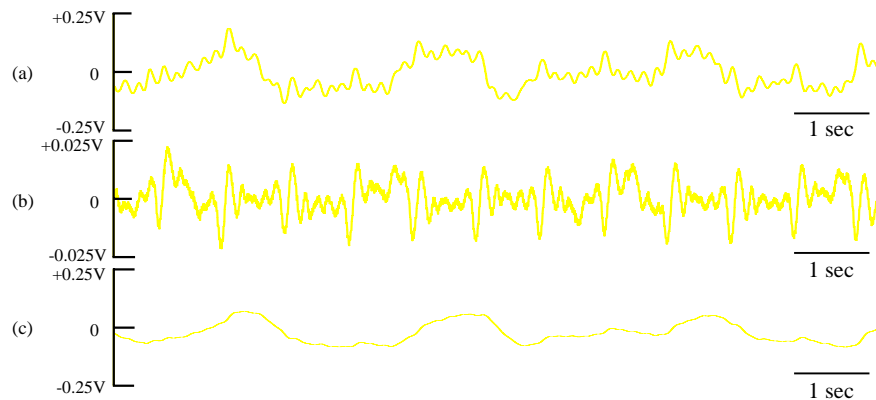

Figure 2 Typical data recorded by the PE1 piezoelectric sensor at laying posture in bed (plot a). The waveform includes cardiac vibrations and respiration signals. The cardiac vibrations are provided by high frequency components of the waveform and the respiration signal is provided by its low frequency components. The heart pulse signal detected by the1.5Hz digital high pass filter (plot b). The respiratory signal detected by the 0.5Hz digital low pass filter (plot c).
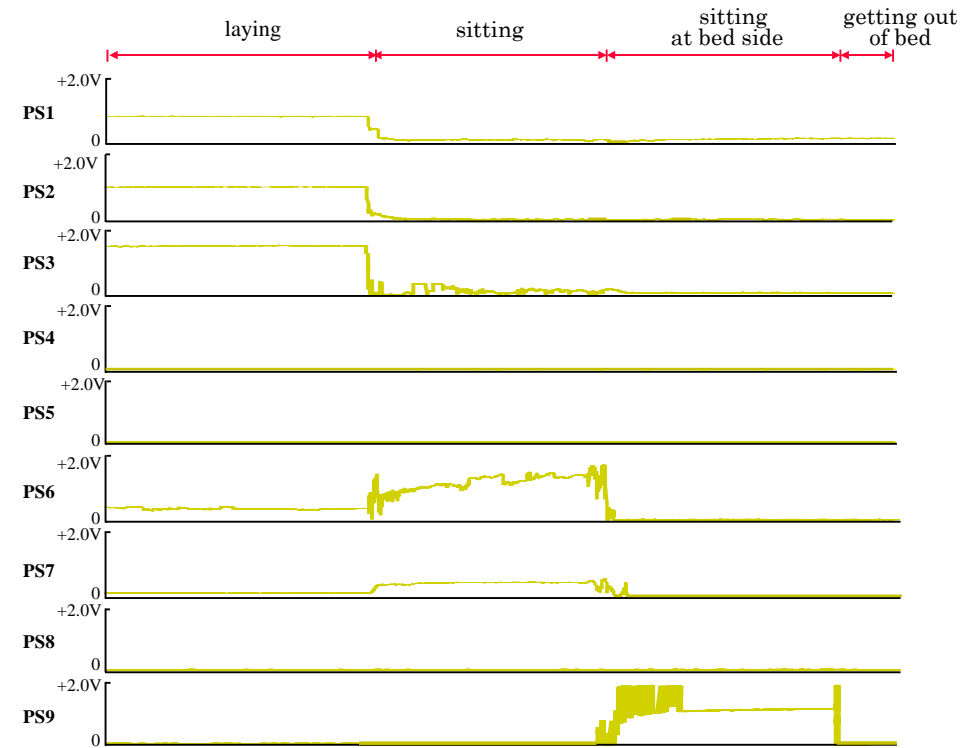

Figure 3 The waveforms recorded by eight small pressure sensors (plot PS1-PS8) and the long pressure sensor (plot PS9) at various postures. The prone posture was detected by both sensors attached to the upper and lower body. The pressures were simultaneously recorded by PS1, PS2, PS3 and PS6. The sitting posture was detected by PS5-8 sensors attached to the lower body. The pressures were recorded by PS6 and PS7. The longer pressure sensor (PS9) attached to the side of the bed detects the sitting posture just before trying to get out of bed. When the subject got out of bed, all pressure sensors ceased to record any pressures.

CONCLUSION

The monitoring system, using four piezoelectric film acceleration sensors, eight small pressure sensors and one long pressure sensor, has been designed for heart pulse, respiration and posture measurement. Whether the subject is lying down or sitting can be detected from the pressures recorded by the pressure sensors. The cardiac vibrations and respiration from upper chest movements were provided by high and low frequency components of the body movements. Furthermore, the computer detects if the patient (often an age-dementia patient) is in bed or trying to get out of bed. In addition to recording significant physiological data, the system also provides protection from the patient's falling down and injuring themselves in attempting to get out of bed - a major problem in all hospitals.