

# Ambulatory Bio-signal Recorder for Individualized Healthcare

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## INTRODUCTION

**A**N bio-signal recorder has been developed for individualized healthcare, especially for assistance of sleep disorder diagnosis. The target bio-signals are electroencephalogram (EEG), electrocardiogram (ECG), body acceleration and ambient temperature (aTemp) during daily lives, because these signals enable us to estimate one's sleep depth and physical activities in ordinary days, not in extraordinary circumstances as in polysomnography. The size of the device (45mm x 25mm x 65mm, 76g) is more appropriate for ambulatory recording than that of the well-known devices such as LifeGuard[1] (129mm x 100mm x 20mm, 166g), AMON[2] (286g) and Smart Vest[3] (460g).

## MATERIALS AND METHODS

Figure 1 shows photographs of the developed device. The device consists of an analog circuit, an accelerometer, a mixed-signal microcontroller, a memory card and batteries. The analog circuit amplifies EEG and ECG signals by 60dB and 46dB, respectively. This circuit also has bandpass characteristics with the passband from 0.5Hz to 100Hz. The accelerometer provides digital outputs of three-axis acceleration of body movement ranged in  $\pm 8g$ . The mixed-signal microcontroller (MSP430F4270, Texas Instruments, USA) converts analog signals (EEG, ECG and

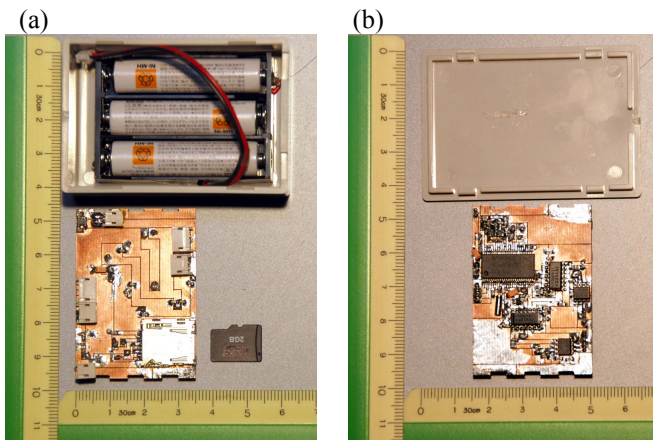


Fig. 1. Photographs of the developed device: (a) the obverse side of the circuit board, a memory card, and batteries in enclosure case. (b) the reverse side of the circuit board and a lid of the enclosure case.

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aTemp) to digital signals with 16-bit resolution at the sampling rates of 256Hz (EEG and ECG) and 8Hz (aTemp). This microcontroller also collects and records the digital data into the memory card. The memory card can store digital data up to 2GBytes, large enough for several-day recordings. All these electric components are powered by three AAA-size Ni-MH rechargeable batteries with a voltage regulator,

The applicability of the developed device was evaluated in preliminary test measurements. The power consumption of the device was also measured.

## RESULTS

Waveforms of EEG and ECG obtained in a preliminary measurement are shown in Fig.2. The results are applicable to brief assessment of sleep/wake state and physical activity. Power consumption of the device is approximately 95mW, which allows 24-hour recording of the target bio-signals with commercially available rechargeable batteries. Using this device, one can record bio-signals during daily lives and utilize them for individualized healthcare.

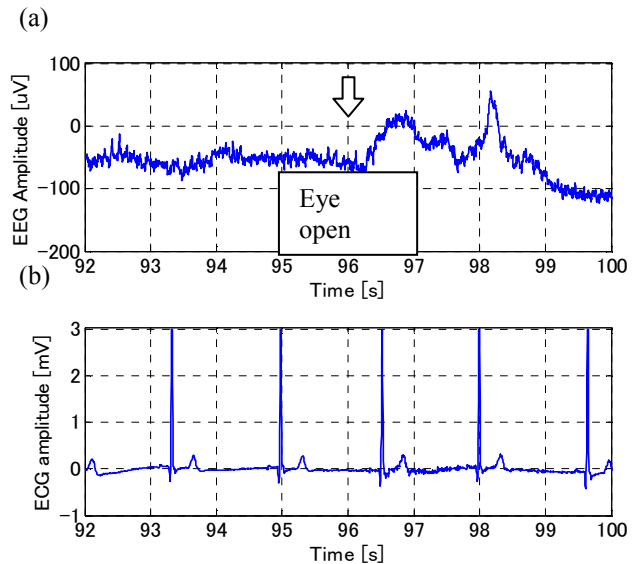


Fig. 2. Waveforms obtained from the developed device in a preliminary measurement: (a) EEG waveform, (b) ECG waveform.

## REFERENCES

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