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Respiratory belt transducer constructed using a singing greeting card beeper

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AN ARTICLE by Belušič and Zupančič (1) described the construction of a finger pulse sensor using a singing greeting card beeper. We felt that this beeper made of piezoelectric material could be easily modified to function as a respiratory belt transducer to monitor respiratory movements. Commercially available respiratory belt transducers, such as Pneumotrace (http://www.adinstruments.com/products/mlt1132; marketed by AD Instruments), also use such piezoelectric material. After modification, the beeper was attached to the chest using Velcro straps. The strain induced on the piezoelectric material of the beeper by the chest movement produces a corresponding voltage change, which can be recorded by a computer using data-acquisition systems or observed using an oscilloscope. The construction of the respiratory belt transducer is described below.[1]

Materials needed. The following materials are needed for the construction of the respiratory belt transducer (Fig. 1):

- Beeper of a singing greeting card or buzzer (~2.5 cm in diameter)
- Velcro strap (60 cm long and 2.5 cm wide)
- Latex strip (25–30 cm long and 2 cm wide)
- Copper wire (1–2 mm thick)
- Fast curing epoxy compound

Construction of the respiratory belt transducer. The copper wire was bent and cut to make two brackets of 2 cm length each. They were soldered to both sides of the metal surface of the beeper (Fig. 1*A*). A small quantity of resin base and hardener of a fast curing epoxy compound (M-Seal, Pidilite Industries) was thoroughly mixed and fixed at the center of the metal surface of the beeper (Fig. 1*B*). The protrusion thus formed (knob) transfers horizontal chest movement into a vertical strain over the piezoelectric material. Once the mixed epoxy compound had set, the latex strip was inserted through the brackets such that it passed over the knob made of epoxy (Fig. 1*C*). The ends of the latex strip were then stapled to the Velcro strap (Fig. 1, *C–E*). The wires from the beeper were connected to the input of a custom-built data-acquisition system (CMCdaq) to record respiratory movements. A video of the construction of the respiratory belt transducer can be seen here: http://www.youtube.com/watch?v=brTVT--qcwI&feature=youtube.

Recording of respiratory movements. Normal respiratory movements were recorded by strapping the respiratory belt transducer to the chest at the level of the nipple. The transducer also responded very well to rapid respiratory movements (Fig. 2). A demonstration of respiratory sinus arrhythmia was done for undergraduate medical students during a theory lecture using this transducer along with the finger pulse sensor described in the article by Belušič and Zupančič (1). Construction of this transducer was also given as a practical assignment to Master of

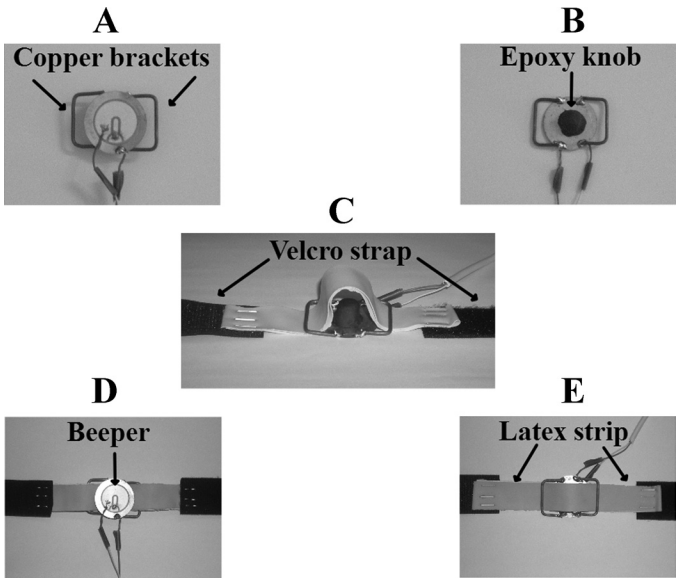

Fig. 1. Parts of the respiratory belt transducer. *A*: piezoelectric beeper (front view). *B*: piezoelectric beeper (back view). *C*: respiratory belt transducer (side view). *D*: respiratory belt transducer (front view). *E*: respiratory belt transducer (back view).

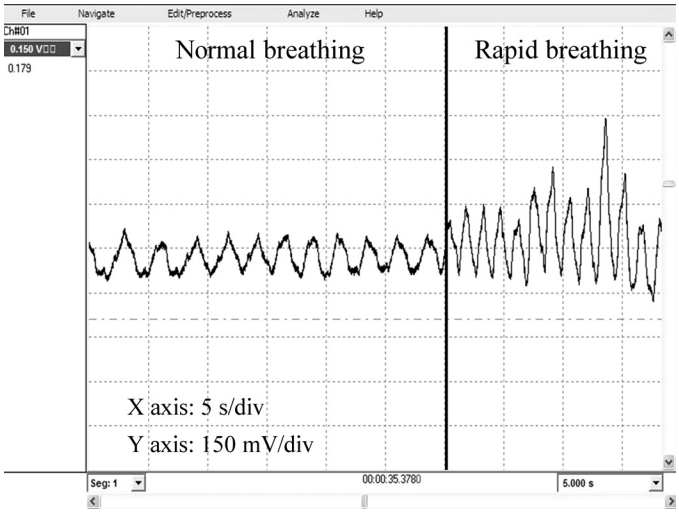

Fig. 2. Respiratory movements recorded using a computerized data-acquisition system (CMCdaq). The waveform on the *left* was recorded during normal breathing, and the waveform on the *right* shows the response to rapid deep breathing.

[1]A video demonstrating the construction of the respiratory belt transducer is available as Supplemental Material at the *Advance in Physiology Education* website.

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Technology Clinical Engineering students, and they were able to construct it quite easily.

This transducer can be used to monitor the depth and rate of respiration. It can also be used to record respiratory movements in animals. The respiratory belt transducer is versatile enough to be connected to other data-acquisition systems, such as BIOPAC or PowerLab, to record respiratory movements for teaching or research purposes. This respiratory belt transducer can be easily constructed, and it is inexpensive (costs $\sim$ \$2) compared with other commercially available respiratory belt transducers.

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DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author(s).

AUTHOR CONTRIBUTIONS

Author contributions: A.B. and R.O. conception and design of research; A.B. and S.S. performed experiments; A.B. and R.O. analyzed data; A.B. and R.O. interpreted results of experiments; A.B., S.S., and R.O. prepared figures; A.B. drafted manuscript; A.B. and R.O. edited and revised manuscript; A.B., S.S., and R.O. approved final version of manuscript.

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