

Breathing pattern characterization based on wireless e-textile antenna-sensor for respiratory disease surveillance

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ABSTRACT

- An embroidered meander dipole antenna-based sensor integrated into a T-shirt with a Bluetooth transmitter for real-time breathing monitoring.
- The respiratory signal is extracted from the received signal strength indicator (RSSI) emitted from the antenna sensor and detected wirelessly by a base station.

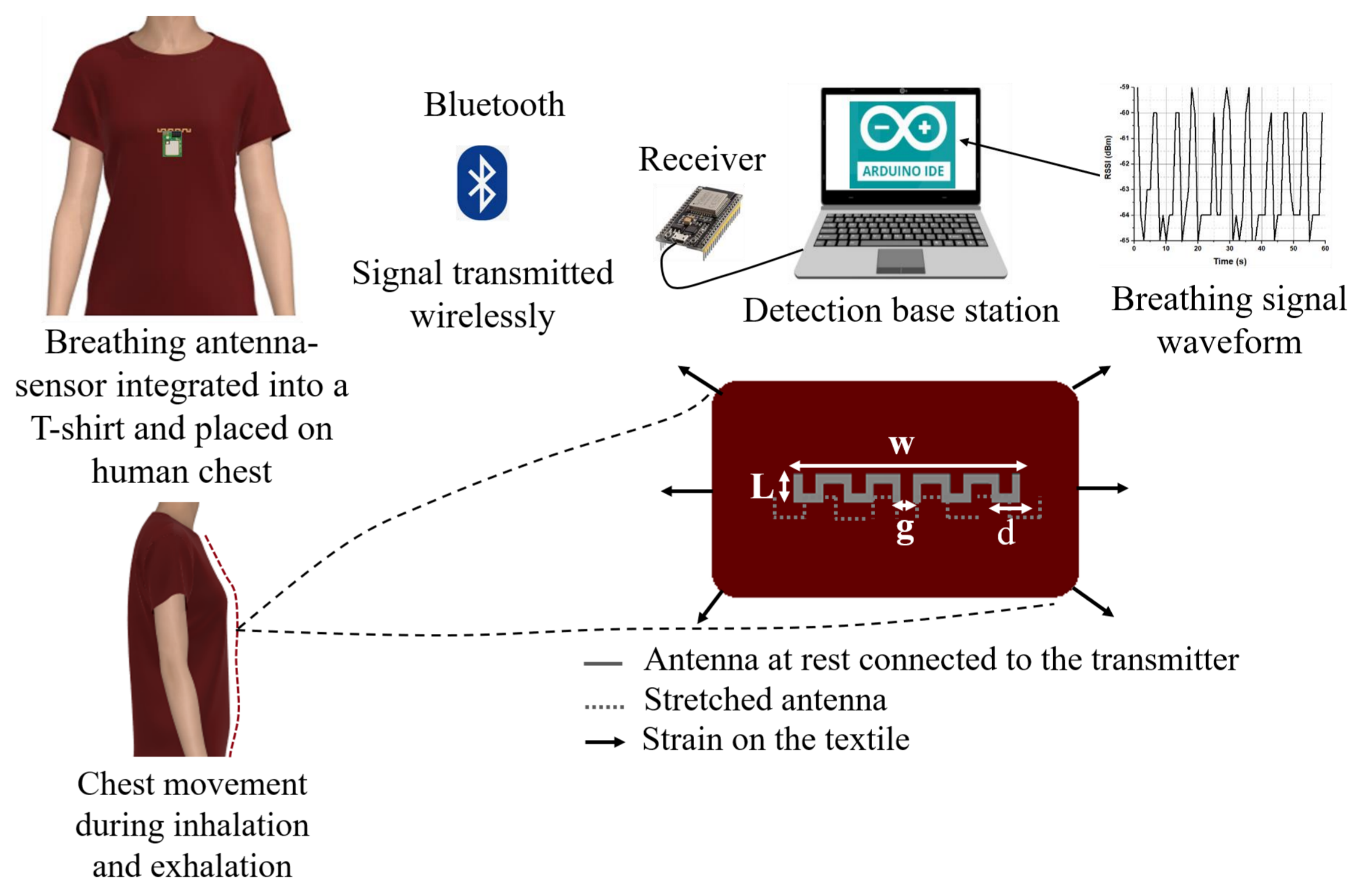
MATERIAL

- T-shirt: $\epsilon_r = 1.3$, $\tan\delta = 0.0058$, $t = 0.88$ mm
- Conductive Yarn: 99% silver-plated Nylon
- Bluetooth transmitter module: ESP32-WROOM-32UE
- Receiver Bluetooth module ESP32 ESP-WROOM-32

MEASUREMENT CHARACTERIZATION

The working mechanism of the platform:

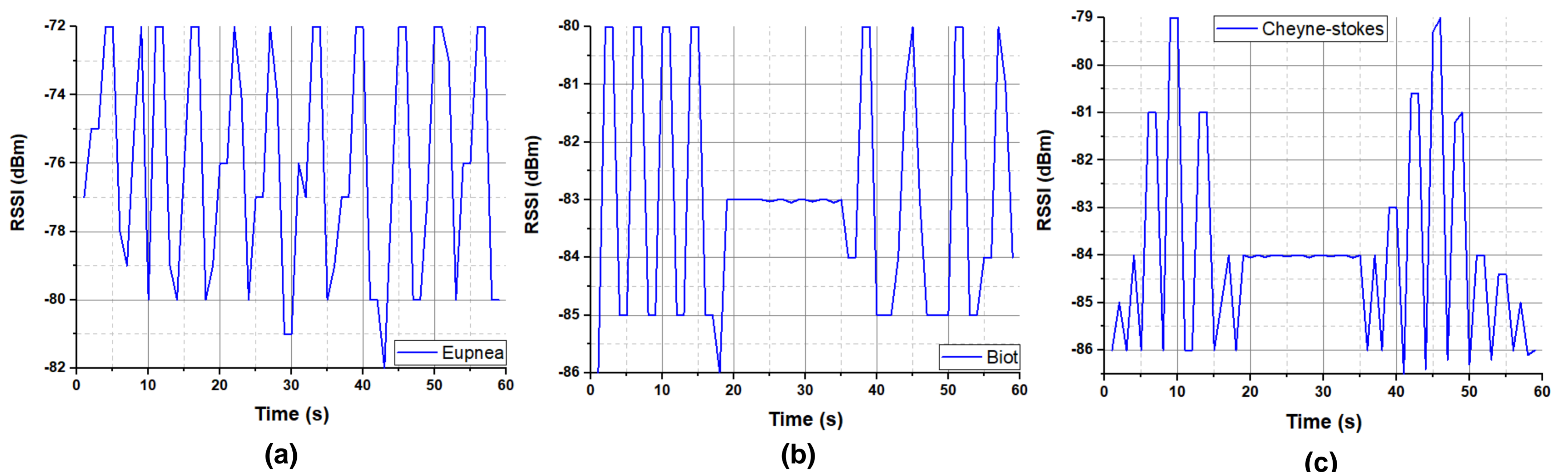
- The breathing antenna-based sensor is stitched on an elastic T-shirt worn by a volunteer and placed horizontally in the pectoral region of the chest.
- Breathing causes significant chest movement.
- The transmitted signal from the sensor is sensitive to strain caused by the chest movement.
- The breathing signal is recorded through the detection of the transmitted RSSI for different breathing patterns.



Textile antenna sensor dimensions

Design	L	d	w	g
Value (mm)	4.8	45	2	7.6

RESULTS



RSSI measurements of different breathing patterns of an adult female volunteer in sitting position, (a) Eupnea, (b) Biot, and (c) Cheyne-stokes

CONCLUSIONS

An embroidered antenna-based sensor embedded into a t-shirt with a transmitter Bluetooth module was presented. The fully wearable and comfortable system monitors respiration of different breathing patterns by using a wireless system that provides breathing signal data through the RSSI measurements via standard Bluetooth protocol. The proposed system ensures a continuous monitoring of the user's respiration through a wireless system. The antenna-sensor can be used as a potential device for healthcare applications concerning the continuous monitoring of respiratory diseases.

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