Poster: Exploring an Inclusive User Interface through Respiration

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CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; **User centered design**; **Accessibility**;

EXTENDED ABSTRACT

Introduction: To date, the most widely deployed human-computer interface is based on keyboards and mouses. However, they are not applicable for users with disabilities. Existing solutions, such as brain-computer interface [1] and eye movements [6], lack of either stability and privacy-preservation [3, 4]. Respiration is a universal, inconspicuous and controllable physiology feature that an individual can control the sequence, the strength, the length of inhalation and exhalation without noticeable movement. To this end, we propose a proof-of-concept respiration-based human-computer interface with its application to user password login. By utilizing a portable and cost-effective radio-frequency radar, the user can create her own password through respiratory pattern in a secure and inclusive manner.

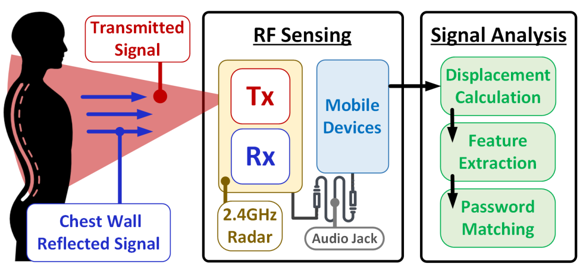

Figure 1: A brief illustration of our respiratory-based user interface for computer login applications.

Methodology: As shown in Fig. 1, we utilize a 2.4*GHz* radar [5] to measure the displacement of chest wall caused by respirations based on the reflected signal. The received sensing signal can output to a mobile device through audio jack. Our signal analysis first derive the displacement of chest wall for segmenting the received signal to inhalations and exhalations (see Fig. 2). Secondly, *three* features are extracted for forming a respiratory password: (a) respiratory sequence: we encode the signal into a ±1 sequence such that an inhalation is +1 and an exhalation is −1; (b) respiratory strength: this is the amplitude of chest wall displacement; (c) respiratory rhythm: this feature includes the duration of inhalation, exhalation and still (i.e., when the displacement is near zero). Finally, we provide *four* password matching schemes: (1) Only (a) needs to be matched. (2) Both (a) and (b) need to be matched. (3) Both (a) and (c) need to be matched. (4) All features need to be matched.

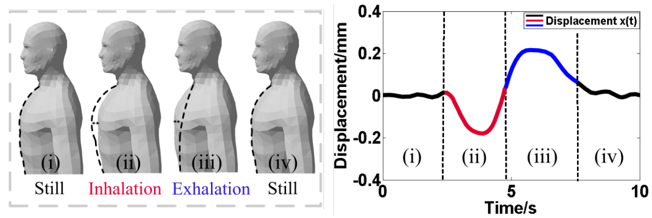

Figure 2: A normal respiratory pattern in the domain of chest wall displacement.

Proof-of-Concept Study: Seven subjects (age: 25.83 ± 2.79; 3 females) participate in our proof-of-concept experiment. They first perform a general study that each subject is required to create a respiratory password and then uses the built password to login a laptop based system 30 times. We evaluate the performance using false reject rate (FRR) [2]. Our participants are asked to perform a second study such that each person eavesdrops a user's respiratory password 2 meters away and then try to login the system with the eavesdropped password. In here, we focus on evaluating false accept rate [2]. In Table. 1, we present all the experimental results (mean ± standard deviation).

Table 1: Experimental Results

	Scheme 1	Scheme 2	Scheme 3	Scheme 4
FRR(%)	5.20 ± 0.02	10.60 ± 4.16	7.70 ± 5.73	3.60 ± 1.33
FAR(%)	52.63 ± 30.35	8.07 ± 12.80	6.61 ± 11.96	1.01 ± 1.05

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