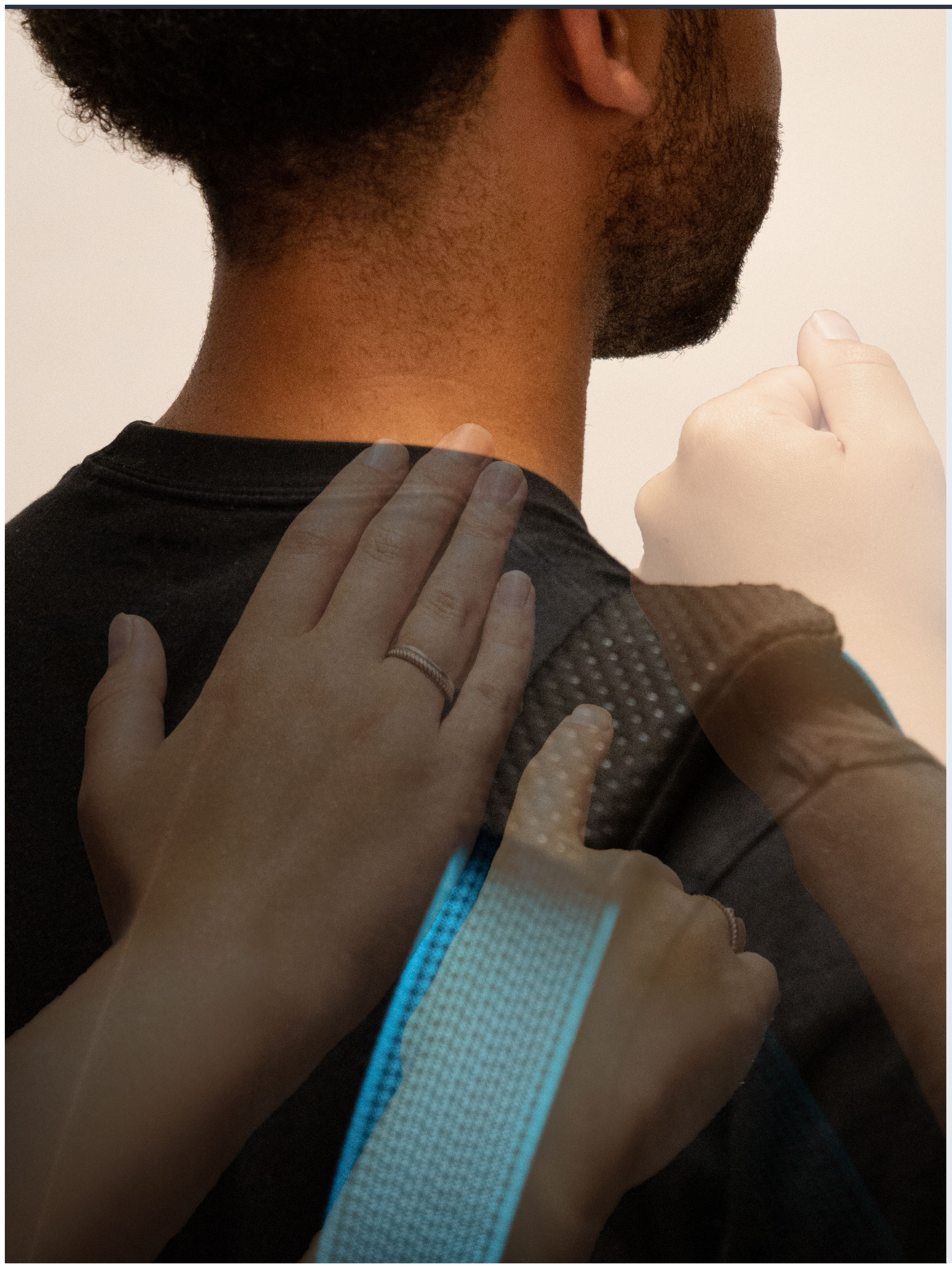
AffectiveAir

Exploring pneumatic affective haptics on the shoulder



AffectiveAir is a **wearable** device designed to deliver **affective touch** sensations on the shoulder using **pneumatic actuation**. It embodies a rich library of pneumatic actuations enabled by a combination of fitting hardware prototype and custom software. The software allows for adjustments in pressure covering multiple distinguishable levels for the wearer and tailored timing for either rapid or prolonged actuation depending on the requirement. Adjusting these variables in the prototype conveys different affective states, each with its own characteristics. For research and development purposes, the software also tracks sensor data and logs all information during either technical or user research.

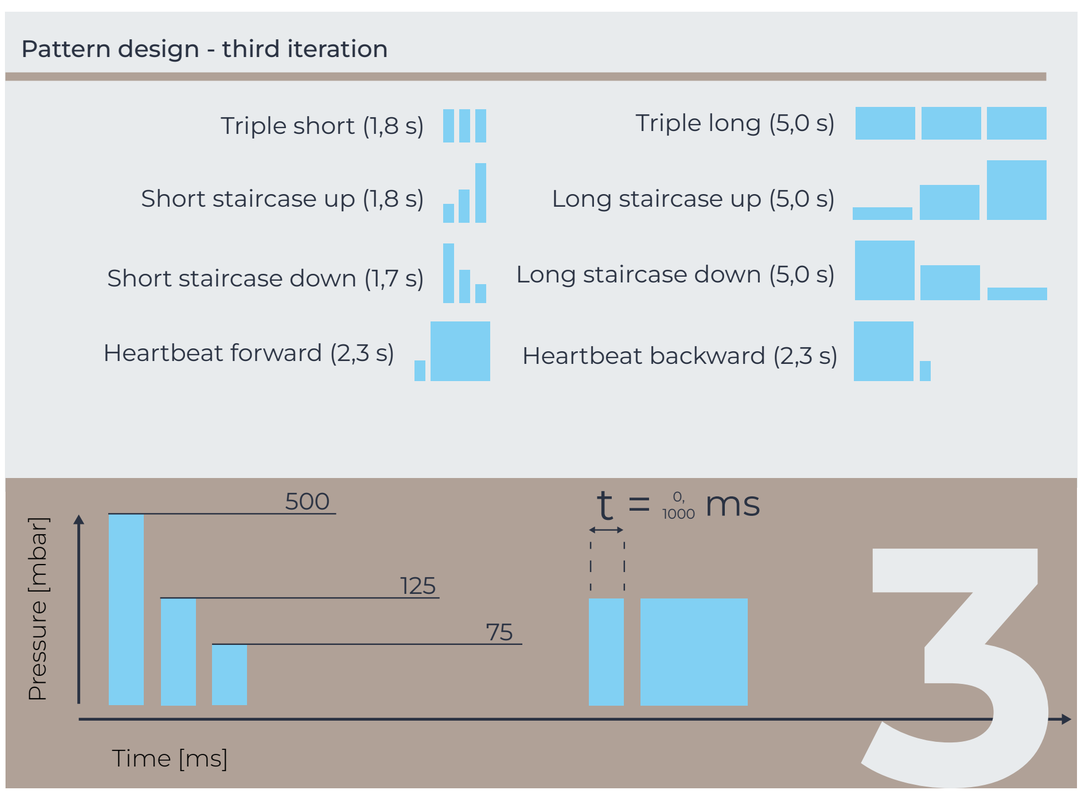
The wearable component of AffectiveAir offers comfort and ease of use. **An elastic band is worn over the shoulder** and attached to the wearer their paints, offering a tailored solution and optimal mobility. The actuator itself is designed using **thin flexible polyurethane** plies and a single nozzle integrated into the airbag, offering a slim actuator solution integrated with textile.

The hardware controlling the pneumatics is connected externally during the research. The pumps offer **inflation times under 1000- and deflation within 100 milliseconds**. It also contains seven valves, providing control over the system's behavior and opportunity for future expandability. An **air pressure sensor** offers precise measurements and can be freely positioned at any location in the system. Additionally, a **force sensitive resistor** located on the airbag offers measurements of the translational force to the wearer. It also checks for ambient conditions such as standard fitting pressure. Valuable tube and wire connection points have a quick-release solution offering easy interchangeability of components in the prototype.

The iterations of AffectiveAir are influenced by the results of user tests during the project. The first test showed potential for locating pneumatic actuation on the shoulder in combination with an airbag of 40x40mm. Qualitative **user feedback** indicated that this was one of the optimal solutions between intensity and comfort, while it could also present a novel approach compared to prior studies in literature.

User test determined optimal pressure levels for haptic feedback in the system. 75, 200, and 500 mbar offered a **wide and identifiable range of pressures**. The final pneumatic pattern designs integrate these levels and show an identification rate of 44% to 85% on 8 patterns ranging from three short pulses on the same pressure level to a heartbeat-like waveform. Overall findings indicate that variable pressure could characterize a pneumatic pattern more effectively than variable timing. Feedback from interviews showed how this form of pneumatic actuation was experienced as rather **novel** and received positive responses overall. The feedback from the device was often viewed as somewhat **intimate**, leading to an interesting dynamic in user attitudes. Some participants showed a degree of openness towards using such tactile sensations in interactions with friends, yet there was a general reluctance towards the idea of employing these interactions with strangers.

AffectiveAir is the embodiment of months of research, iterative prototyping, and user tests, showing both effective and affective touch using air offering potential for application in a variety of contexts for mediated interaction and future research.



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