Direct manipulation with flexible devices

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Human-Computer Interaction (HCI) research constantly explores new input and output modalities. *Flexible devices* are a relatively new approach that offers continuous input modality. Similarly to joysticks, flexible devices pertain to the category of elastic devices. They move back to their initial position when the user releases them. Depending on their elasticity, they either behave like an *isotonic* (like a mouse) or *isometric* device (like a trackpoint).

Previous research on flexible devices explored gestures [5], sensing technologies and form factors [1], or combinations with other input [2] or output [4] modalities. But there is still a large design space to explore, with multiple combinations of form factors and modalities, feedback, and other factors to be determined.
In this thesis, the candidate will design, implement and evaluate new flexible devices and interaction techniques in relevant contexts an application domains to be identified (e.g., mobile interaction, creativity support tools, control with numerous degrees of freedom such as robotics, etc.). On a more theoretical perspective, he, or she, will study the relation between input actions and feedback (sensory-motor loop) in this very new and particular context, in order to inform the design of efficient flexible devices for *direct manipulation* [3].

Description

The candidate work will consist in :

- Studying related work on direct manipulation, flexible devices, the sensory-motor loop.
- Defining a design space for flexible devices and related interaction techniques.
- Designing new flexible hardware and software interaction techniques in order to explore, enrich and validate the proposed design space.

Candidate

A successful candidate must hold a MSc in computer science or equivalent, and show a great interest in performing high quality research in Human-Computer Interaction. Skills in electronics and fabrication would be a plus. He or she must speak and write English fluently, and experience or strong interest in software and hardware development. Creativity, independence, team working and communication skills are valuable advantages.

Working environment

The thesis will be carried out in two locations (1.5 years at each):

- The Loki team in Lille, France, joint between Inria – Lille Nord Europe and the CRIStAL (UMR CNRS 9189) laboratory of the University of Lille.
  Supervisors: Thomas Pietrzak and Stéphane Huot.
- The CIL laboratory in Ottawa, Canada, from the CSIT department of the Carleton University.
  Supervisor: Audrey Girouard.

References

[1] Fellion, N., Pietrzak, T., Girouard, A. FlexStylus: Leveraging bend input for pen interaction. UIST'17, 375–385.

[2] Lahey, B., Girouard, A., Burleson, W., Vertegaal, R. PaperPhone: Understanding the use of bend gestures in mobile devices with flexible electronic paper displays. CHI'11, 1303–1312.

[3] Shneiderman, B. Direct manipulation: A step beyond programming languages. Computer. 16, 8 (Aug. 1983), 57–69.

[4] Strohmeier, P., Burstyn, J., Carrascal, J.P., Levesque, V., Vertegaal, R. ReFlex: A flexible smartphone with active haptic feedback for bend input. TEI'16, 185–192.

[5] Warren, K., Lo, J., Vadgama, V., Girouard, A. Bending the rules: Bend gesture classification for flexible displays.