Implicit Human-Computer Interaction through A Model of Human Contexts

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Computers, in general, are blind to the humankind's world. Therefore, when designing interactions between humans and computers, it is almost customary to assume that "human users will walk up to the computer side." Previous efforts adhering to such a premise include the Direct Manipulation interaction style; it generally provides mediums "for human users" to send commands to their computers, contributing to establish explicit communication channels between the two ends. In practice, computers' behaviors remain quite static when interactions rely only on such explicit channels. Computers (mindlessly) react to commands explicitly provided, hindering themselves from becoming genuine collaborators.

This dissertation explores opportunities in designing implicit communication channels between the two ends, aiming to complement computers' behaviors. This dissertation discusses two points of exploration. First, it presents a framework to encapsulate the fundamental features of implicit channels. The framework provides a conceptual medium "for computers" to perceive a part of the humankind's world, empowering "computers to walk up to the human side." In particular, the work in this dissertation leverages physiological sensing technology and demonstrates how a computer can improve its behavior by taking the physiological context of its user into account. This dissertation also investigates the complementary nature of the implicit and explicit channels; it then presents a domain-specific language to accommodate ever-increasing complexity in implementing interactive systems. The language provides a set of type-level abstractions linked with common constructs in interaction designs, allowing programmers to encode interactions into composable units of computer behaviors. This dissertation foresees that computers capable of understanding humans' contexts will be increasingly crucial in the future, where humans interact with intelligent computers more frequently. The proposed framework and language make it possible for computers to be more aware of their human users and, in turn, for humans to benefit from the considerate behaviors of their computers.