Using fNIRS to Support User Interfaces

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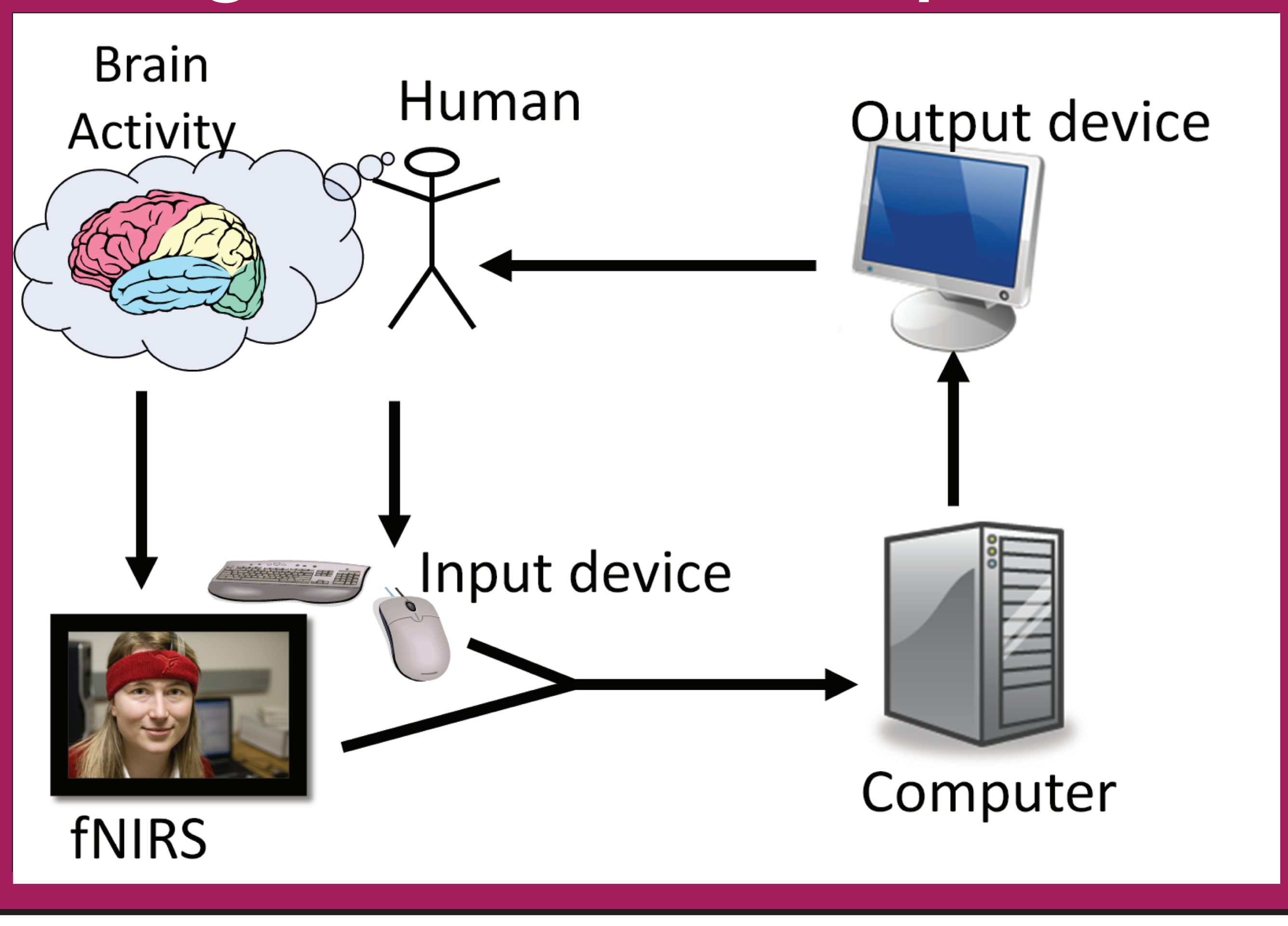
As human-computer interaction (HCI) researchers, we strive to improve user experience & user performance when using interactive computer systems. Over the past fifty years, computers have gained power and efficiency, and can now process massive amounts of information at high speeds. Humans, on the other hand, have not witnessed such dramatic improvements. Thus, we develop interaction techniques to make humans more effective when they interact with computer systems. Current interaction techniques (mouse, keyboard, monitor) still are not able to capture the richness of the user's thoughts and intentions when interacting with a computer system. Using fNIRS, we can augment these systems to provide richer user experience and improve user performance.

Passive input to augment human-computer interaction system

fNIRS can open new doors for HCI research since it is safe, non-invasive, and portable, yet still provides cognitive state information. If used with care, this additional information can lead to interfaces that adapt appropriately to changes in the user's cognitive state. We aim to identify the best use of this cognitive state information in user interfaces.



We make use of the fNIRS signal as an additional input channel, providing hard-to-detect information such affective and cognitive states of the user. We are developing strategies for real-time utilization of this information to enhance the user experience. The systems will sense natural signals without requiring any additional effort from the user.

Brain Sensing for Human-Computer Interaction

Functional Near-Infrared Spectroscopy

Safe
Non-Invasive
Portable
Practical for HCI Settings

Quick set up time
Permits regular computer usage
Few constraints on user's position
Comfortable
Few interruptions of task
Continuous, real time measure

Characteristics of brain input

* Implicit
* Noisy
* Constantly changing
* Imperfect classification of state
* Continuous

With these characteristics, can we still build user interfaces? How should they be designed? What domains could use this type of input? These are some of the questions that I hope to address in my research. By understanding the unique properties of the brain input, new paradigms for interaction can be developed.

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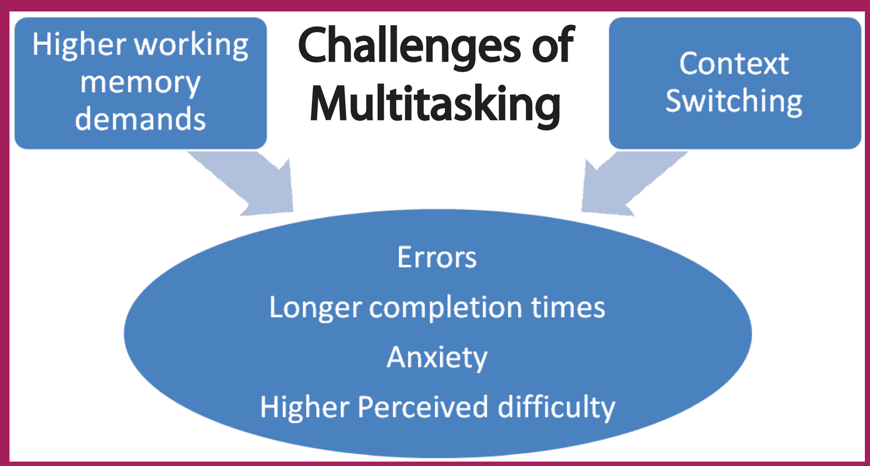
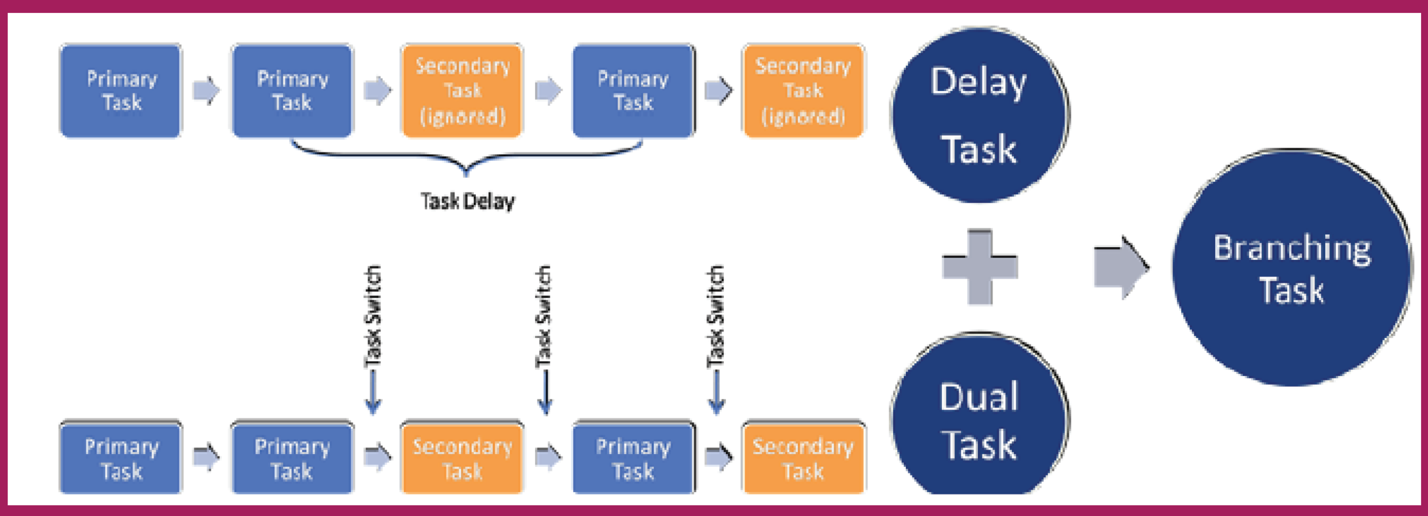
An Example: Detecting Cognitive Multitasking in a User Interface



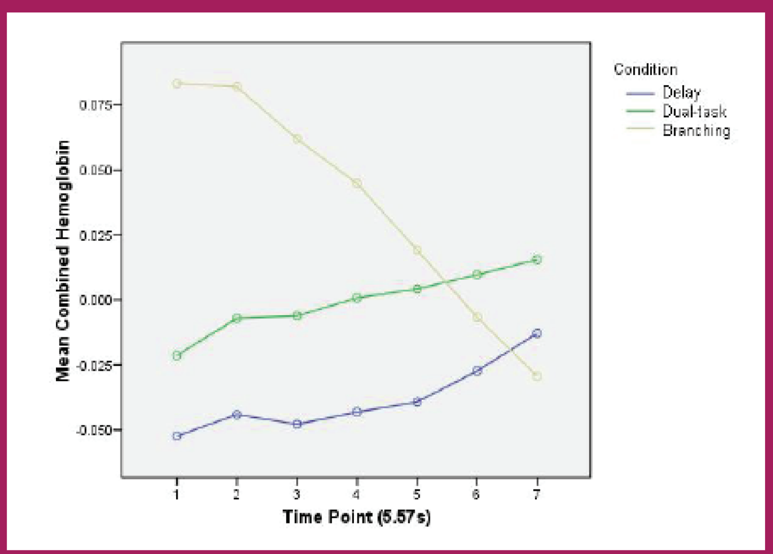


MULTITASKING SCENARIOS

Delay Task: Primary task goal held in mind over time. Secondary task requires little or no attention.

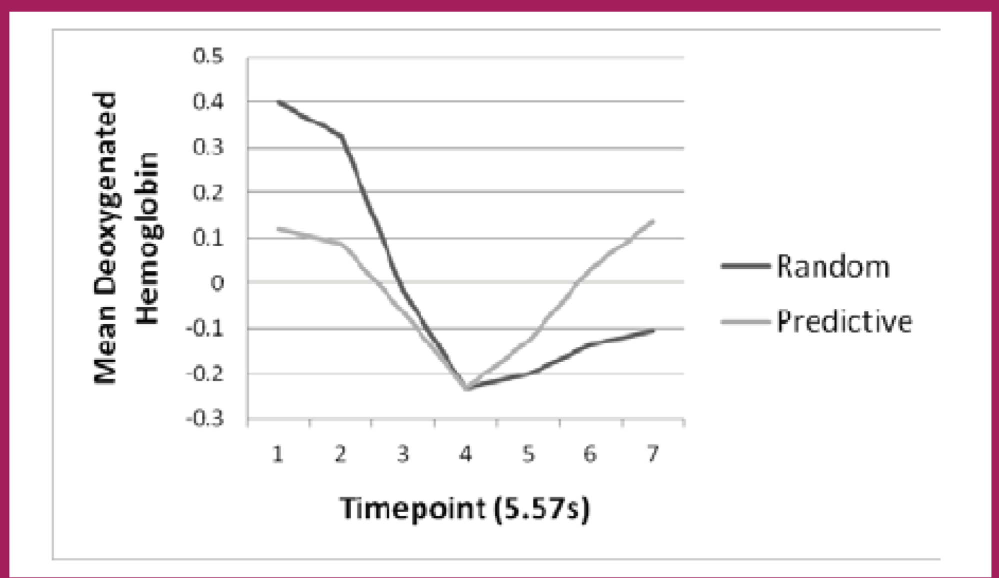
Dual-Task: Primary & secondary tasks require allocation of attentional resources.

Branching: Primary & secondary task require allocation of attentional resources & and the primary task goal must be kept in mind over time.



* Able to distinguish conditions automatically with fNIRS data

* Adapt user interface, based on recognition of particular multitasking state



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