

Psychophysiology of Human - Computer Interaction (HCI) and the Role of Haptic Feedback in Emotional Regulation

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Abstract: *Mortal computer commerce (HCI) groups are more and more frequently exploring the mileage of new, lower cost electroencephalography (EEG) interfaces for assessing stoner engagement and experience as well as for directly controlling computers. While the implicit benefits of using EEG are considerable, we argue that exploration is fluently driven by what we name naive neorealism. That is, data attained with psychophysiological bias have poor trustability and uncertain validity, making consequences on internal countries delicate. This means that unless sufficient care is taken to address the essential failings, the benefactions of psychophysiological mortal computer commerce are limited to their novelty value rather than bringing scientific advance. Then, we outline the nature and inflexibility of the trustability and validity problems and give practical suggestions for HCI experimenters and pundits on the way forward, and which obstacles to avoid. Actors preferred haptic announcement over no announcement at interruption time, and combined haptic and visual display of bookmarks to support navigation to their interrupted position at resumption time. Our benefactions include an approach to handling noisy data in implicit HCI, an perpetration of haptic announcements that gesture implicit system geste, and discussion of stoner internal models that may be active in this environment.*

Keywords: Human computer interaction (HCI), electroencephalography (EEG), naive neorealism, haptic feedback, mental models

1. Introduction

Touch has an important part in social communication, regulating physiological countries and natural and social development state that because of its significance in early life, touch may establish the foundation of all other forms of mortal communication. Indeed, though the frequency of touch contact decreases after nonage, interpersonal touch is inversely important in majority. Touch can have common meanings between societies, and abecedarian uses include communication of comfort, attachment, and aggression. The part of touch in everyday non - remote communication between people isn't supported in remote communication. Haptic communication systems can be divided into two broad orders grounded on the type of information communicated task - acquainted or affective. The bulk of exploration has concentrated on task - acquainted, non - affective communication. For case, it's possible to shoot haptic guidance cues to a person walking towards a point of interest or convey information of person's presence [1]. Task - acquainted information can be communicated by using Tactons or systems like Tactile Braille. This study is concentrated on interpersonal haptic communication, with a specific emphasis on affective touch. With interpersonal haptic communication, we relate to any communication system that supports agreement of touch between two or further persons. The scoping review was prepared as follows. First, we collected an expansive set of all studies from the most applicable fields in interpersonal communication. Amongst the chosen fields were physiology of the skin, mortal feelings, the part of touch in social communication, haptic technologies, social communication, multimodal technologies, mortal perception, psychology and computer - intermediated haptics. We first linked potentially intriguing in

English. The quests were carried out in ACM Digital Library, IEEE Xplore, MDPI, Elsevier, Scopus and Google Scholar databases. We also used the reference lists and lists of papers pertaining to chosen studies of all named papers and papers to find fresh applicable papers. After an analysis of words contained in the title, abstract, or indicator terms, we named potentially intriguing stud. The study were retained only if they contained information related to interpersonal haptics or the scientific background (e. g., physiology of the skin) important to design haptics [2].

2. Literature Review

Mounia Ziat (2023) In recent years haptics has received considerable attention from the field of Human - Computer Interactions (HCI) for its potential to provide more tangible and immersive interfaces. In this work, I present a selected review of research in haptics in an attempt to provide HCI and other fields a framework for understanding haptics that will help those fields design better interfaces and, ultimately, new and better experiences for those who interact with technology every day. This collection of essays exposes the reader to the haptics field, the haptic sense, and some examples of haptic technology. They cover over fifty years of research and terminology thus will be a handy reference for any researcher. In the conclusion, I examine the history in light of my own experiences and provide my take on haptics, HCI and what both communities can do to improve research and design [2].

Karon E MacLean (2022) As a central aspect of human physical and emotional experience, affect needs to be incorporated into the discipline of haptic experience design, which is emerging alongside the last decade's maturation of haptic technology. Meanwhile, haptic science fields such as

neuroscience and cognitive and social psychology are contributing to knowledge of affective mechanisms and behavior. However, developments in these three areas are often siloed, due to the complexity of the systems being studied or built, diversity of methods employed and distance between the home disciplines of the respective researchers. To facilitate greater bridging, this article offers a glimpse of how practitioners of haptic design conceptualize their work, and ways in which researchers working in these disciplines can jointly identify and fill gaps [3].

Gina Clepper (2022) Virtual reality has been used in recent years for artistic expression and as a tool to engage visitors by creating immersive experiences. Most of these immersive installations incorporate visuals and sounds to enhance the user's interaction with the artistic pieces. Very few, however, involve physical or haptic interaction. This paper investigates virtual walking on paintings using passive haptics. More specifically we combined vibrations and ultrasound technology on the feet using four different configurations to evaluate users' immersion while they are virtually walking on paintings that transform into 3D landscapes. Results show that participants with higher immersive tendencies experienced the virtual walking by reporting illusory movement of their body regardless the haptic configuration used [5].

Katri Salminen (2022) Touch between people is an integral part of human life. Touch is used to convey information, emotions, and other social cues. Still, everyday remote communication remains mainly auditory or audio - visual. The theme of this article, interpersonal haptic communication, refers to any communication system that supports mediation of touch between two or more persons. We first present a scoping review of the state of the art in interpersonal haptic communication, including physiological and psychological basis of touch, affective and social touch, and mediated social touch. We then discuss emerging research themes that shape the future of interpersonal haptic communication, identify research gaps and propose key research directions for each theme. Finally, societal impact and ethical aspects are discussed [6].

Ravinder Dahiya (2021) Wearable human machine interfaces (HMI) such as smart gloves have attracted considerable interest in recent years. The quality of the interactive experience with the real and virtual world using wearable HMI technologies depends on the intuitive two - way haptic interfaces they offer and the real - time touch - based information they send and receive. Herein, various smart glove solutions and their application in interaction, rehabilitation, virtual (VR) and augmented reality (AR), and augmentative and alternative communication (AAC) tasks are reviewed. While the early variants of such systems were based on commercial touch sensors and displays integrated (e. g., stitched) on wearables, electronic skin (e - skin) - type technologies with multifunctional capabilities are being explored nowadays for rich user experience and comfort [8].

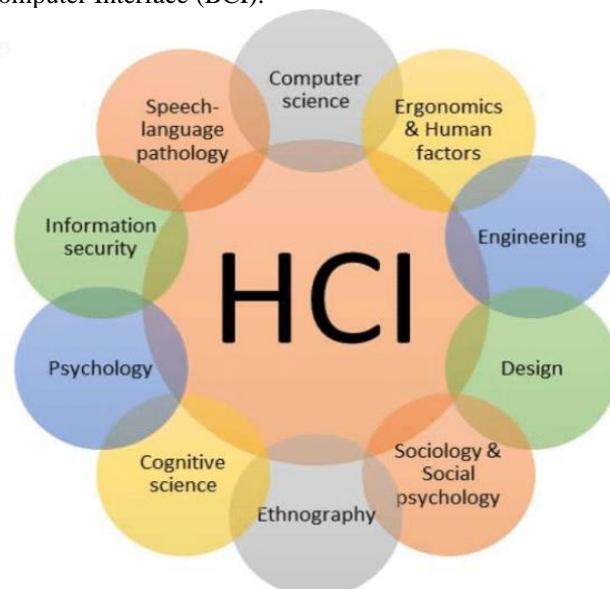
The psychology of human computer interface

Connected psychology is grounded essential exploration in psychology. In the 1980s, multitudinous computer wisdom understudies and experts were tested with structure

straightforward and natural interfaces for computer fabrics, especially in perspective of rising connection styles dependent upon a graphical customer interface. Obviously, interrogate about in mortal tactile, cognitive, and machine conduct was generally advanced around also. What Card, Moran, and Newell did was interface low position mortal forms with the putatively inoffensive connections humans have with computers e. g., writing or exercising a mouse [4]. The structure for this was the model mortal processor. The model mortal processor had an eye and an observance for tactile enter to a perceptual processor, a mind with a cognitive processor, flash memory, and longterm memory, and an arm, hand, and outlet for machine responses.

EEG in HCI

Berger was also the first to discover nascence swells, one of the most prominent features of the EEG. nascence swells are fluently observed as a stereotypical oscillation in the range of 8 Hz - 12 Hz that can be observed over much of the crown. As they appear in the absence of prominent stimulants, they're frequently used as an indicator of relaxation, or brain inactivity (still, observation of nascence swells alone is n't a sufficient condition to conclude that a reduction of brain exertion took place [5]. Due to its characteristics (fairly high breadth and trustability), the P3 allowed experimenters to develop the P3 lexicon, the first working case of a Brain - Computer Interface (BCI).



Human - Computer Interaction

This is particularly useful for cases with serious disabilities, similar as the locked - in pattern, for whom a BCI may be the most effective way to communicate. As computer technology increased in quality and vacuity, EEG came more and more available across disciplines. The relative ease in which raw brain - related signals can be attained and analysed led to rapid - fire developments. Experimenters and interpreters are now suitable to develop tools grounded on EEG and other physiological measures with common electronic bias. It's now, for illustration, possible to apply a Brain - Controlled address book grounded on the P3 lexicon conception indeed on mobile phones [6].

The Rise of Brain Informed Human Computer Interaction

In HCI, EEG is used for colourful purposes. Affective computing and physiological computing are two integrated branches of this field in both, cognitive and emotional

countries are prognosticated or classified grounded on their physiology (in affective computing, the emotional state is of particular interest).

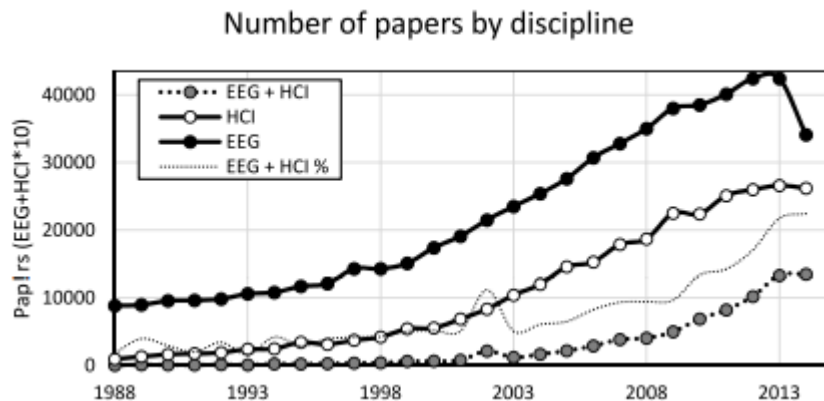


Figure 1: Growing Use of EEG in HCI

Both probe how systems should acclimatize to detected changes in druggies' enjoy countries. For illustration, it has been tried to measure task engagement by using EEG nascence asymmetry, i. e. the difference in nascence power between the two components. In this kind of exploration, two contemporaneous hypotheticals are made originally, nascence power correlates to reduced neural exertion and, secondly, lesser left than right exertion corresponds to positive feelings, and/ or high provocation. Another area worth of note is neurofeedback this area investigates the possibility of erecting systems that take advantage of "tight feedback circles", so that druggies' (or cases', for medical operations) cognitive countries in a predefined direction [7].

Vestiges Noises

The vestiges are swells or groups of swells which are produced by specialized or other disturbances which are n't due to brain exertion. Vestiges include all noises other than EEG. The massive modification magnifies all manner of disturbances similar as EKG and palpitation vestiges, electrode and movement and IV and 50 Hz vestiges and Sweat vestiges. Actually, EEG signal is veritably weak and fluently told by external noise. When all estimation waveform is normal than the muscle artifact is judged as being entered together with an electroencephalogram surge form out of the machine [8].

Development of mortal computer interface and graphical customer interfaces

With the arrangement of cooperation for registering outfit particular vested party on computer mortal connection in 1983 and the discharge and substance of the Apple Macintosh in 1984, mortal computer interface was out and running. Graphical customer interfaces entered the standard and, therefore, a much broader group of guests and scientists were presented to this new kind of cooperation. Microsoft was a snail in graphical customer interfaces. unexpected forms of Microsoft Windows showed up in 1985, yet it wasn't until the appearance of Windows 3.0 (1990) and specifically Windows 3.1 (1992) that Microsoft Windows was conceded a genuine optional to the Macintosh working frame. Microsoft expanded its piece of the pie with enhanced forms of Windows, utmost remarkably Windows 7 (2009). moment,

Microsoft working fabrics for desktop computers have a piece of the overall assiduity of in the ballpark of 84 percent, varied with 15 percent for Apple. With propelling investment in mortal computer interface, all major seminaries presented courses in mortal computer interface or customer interface [11].

Types of EEC Electrodes

Basically, five types of electrodes in EEC technique are used

- **Scalp Electrodes:** Silver pads /disc / cups, stainless steel rods and chloride silver wires.
- **Sphenoidal Electrodes:** Alternating insulated silver and bare wire and chloride tip inserted through muscle tissue by a needle.
- **Nasopharyngeal Electrodes:** Silver rod with silver ball at the tip, inserted through nostrils.
- **Electrocographic Electrodes:** Cotton wicks soaked in saline solution that rests on the brain surface (remove artifacts generated in the cerebrum by each heart beat)
- **Intracerebral Electrodes:** Sheaves of Teflon coated gold or platinum wires cut at various distances from the sheaf - tip used to electrically using an electrode jelly or paste (conductive cream) having similar consistency to body fluids / electrolytes. The area is first cleaned with alcohol or acetone to remove skin oils. The resistance should be blow 10K ohm to ensure good EEG signal recording. The amplitude, phase and frequency of EEG signal depend on electrode placement. This placement is based on the frontal, Parietal, temporal and occipital areas [13].

3. Research Methodology

The present study was exploratory for relating the mortal computer interface in present script and current designs. But as for any type of exploration content, it's veritably important that some publications were review be finished to learn the former and ongoing exploration on the theme named. also, only can the experimenter avoid duplicating exploration finished ahead by someone fresh. At the identical time, it likewise exposes the breaches and scarcities in being knowledge on the subject which this study can contribute to fulfill. In the case of a computer exploration thesis, this is veritably significant because there are multitudinous study

systems going on at different exploration associations. The investigator first had to learn veritably well what are the different mortal computer interface styles and generalities employed most during the time of study so that the investigator can discover from these being practices and construct upon the content. Research styles used were substantially literature review, interviews and conversations. ultimately the data has been collected into a reference form so that the contrivers of unborn mortal computer interface rudiments, can source it while designing their new inventions. The exploration outgrowth is helpful for inventors in order to help them guide how to test and their inventions and gather data related to the feedback for their operations.

4. Data Analysis

Human Computer Interaction is the study of how people interact with computers and to what extent computers are or are not developed for successful commerce with mortal beings. numerous computer druggies still. feel that computer makers are still not paying enough attention to making products stoner friendly an intuitive to use. An important factor oh HCI is that different druggies from different generalizations or internal models about their relations and have different ways of literacy, keeping knowledge and chops. The facial expressions play a major part in how people communicate information they serve as a window to display one's own emotional state, they make gets more accessible to others and they condense verbal communication.

Table 1: The Brain of Average of Left and Right Position

Expression	Neutral	Happy	Sad	Anger	Fear	Surprise	Disgust
VL	5.7	26.50	31.83	37.48	15.22	17.12	22.52
VR	8.16	27.05	29.81	38.45	15.82	15.82	20.98

This section gives the detailed information of brain recording during face expression recognition through digital EEG system of 24 channels, that record the signal of each expressions from the defined four regions of brain. Corresponding to these positions, the average frequency and

the average peak voltage are determined through software available with the system. In this exploration, the average values with their standard diversions have to be calculated and chapter five shows the Fast Fourier Transformation for all subject's face expression.

Table 2: The Brain of Standard Deviation of Left and Right Position

Expression	Neutral	Happy	Sad	Anger	Fear	Surprise	Disgust
VL	6.63	12.06	12.15	14.95	12.77	12.3	11.11
VR	7.40	15.05	9.82	8.50	10.80	11.83	12.55

Table 3: Comparison Between FFT Average Value of Left - Right Position of Brain

Expression	Neutral	Happy	Sad	Anger	Fear	Surprise	Disgust
VL	5.45	20.2	29.7	29.37	14.88	16.8	21.64
VR	7.91	23.55	28.6	29.43	14.91	14.77	19.85
Average VL	5.7	26.50	31.81	37.48	15.21	17.10	22.50
Average VR	8.70	27.5	29.85	38.45	15.82	15.82	20.96

This fashion is used to reduce noise in the signal processing. The Fourier transfigure algorithms are extensively used for spectral analysis of signals. With the help of this system convert the Time sphere signal into frequency sphere signal and reported the FFT of reckoned average values for sensitive analysis of EEG signal for different face expressions of mortal. The Fourier Transform is a important tool for assaying and measuring the signals from draw - in data accession bias.

5. Conclusions

The use of psychophysiology in HCI has been remarkable. We've seen numerous cases in which the emulsion of neuroscience and HCI can produce new perceptivity and operations. still, the fashionability and naive neorealism can lead to an exorbitantly auspicious idea of making psychophysiology a simple plugin of the mortal computer commerce. These expressions formed when person got corresponding situation or also can produce similar terrain like talking, kidding or joking, watching movie or diurnals, that time record the brain exertion or brain swells for similar face expression. After opting stylish expression, did the analysis for all measured face expressions like neutral, happy,

sad, fear, wrathfulness, nausea and surprise but in this exploration some expression like neutral, fear and sad measured in low micro volt and nausea, happy and wrathfulness in high micro volt. More importantly, we bandied issues of trustability and validity that make claims regarding direct mind - control tenuous. The result analysis of neutral, sad and sweat expression measured with low microvolt and nausea, happy and wrathfulness expression with high micro volt. The result contains the fast - flourier transfigure of left right brain position with average and standard diversions values for sensitive analysis of electroencephalography signal to six type of facial expressions. To help this instigative new field, we'd like to conclude with a many question. From our experience, it's useful to keep these questions in mind while developing and presenting EEG - in - HCI operations.

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