Chapter 32
Neuroscience Technology and Interfaces for Speech, Language, and Musical Communication

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ABSTRACT

Medical practice is extensively using monitoring devices that are more or less invasive and immersive. For aural and oral communication these could be hearing aids, prosthetics, cochlear implants, or goggles detecting vestibular effects and vertigo. Recently, a wide variety of trendy mobile or wearable devices has been offered to the general public, provoking a frenzy for augmentation alongside the great expectations that the popularization of brain-computer interfaces has caused to both the consumer market and the scientific community. The use of bionic devices clinched with synapses of the nerves does not merely mingle input activity to brain activity, but also it provides a virtual channel for augmenting and manipulating speech communication, language communication, and even further, musical communication. The electromechanical parameters, the medical practices, and the learning potential for this new world of augmented human-computer interaction platforms and devices are examined under the prism of audio communication.

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INTRODUCTION

Recently, in a continuously changing environment with a wide variety of trendy mobile or wearable devices, in an increasingly demanding market for additional benefits in favor of the end user, the success of a product depends on its ability to adjust to the needs and desires of the consumer. So, new concepts have emerged in spectacular pageantries for the amazed public eyes.

Within this scenic approach, the concept of Interface Design and Usability has come to surface not only for smartphones and tablets, which are definitely powerful computer devices, but also for a variety of wearable or implanted pieces of apparatuses that are in position to perform many of the functions of computing machinery.

Inevitably, the issue of Usability comes to surface, as it measures perhaps more clearly than any other factor, the ability of a product not only to affect the body but also the mind of the user. This seemed to be the situation experienced thus far only with advanced medical devices and prosthetics that enabled monitoring of subtle neurological functionality. Indeed, for diagnostic or therapeutic purposes microsensors, wearable monitoring systems and various imaging assemblages provide an enhanced telecommunication channel between the actual patient organs and the monitoring clinician (Figure 1).

The initial success of implanted or portable devices used for health and fitness reasons has widely promulgated mobile device applications of all types that take advantage of the affordable imaging modalities, the immediate reporting potential, the endoscopic representations of computer generated signals, the tactile sensing, the microrobotic precision, the motion tracking, the stereotactic functionality, the GPS positioning, the accelerometer measuring of shock, vibration or orientation, and many others.

As microprocessor signal pins interface with the internal neurological architecture of the human organism, they synchronize external events with the structure and functionality of the brain. The notion of Usability, extensively used in Human Computer Interaction (HCI), refers to the potency of a product that is massively deployed to end users to bring into action specific targetable derivatives under certain circumstances (Dix et al, 2004). These are measured in terms of:

Figure 1. Wearable and implanted devices used for detecting and ameliorating oral and aural communication. Left: video Frenzel goggles that eliminate vision and provide simultaneous eye movement recording for the Dix-Hallpike maneuver that detects Benign Paroxysmal Positional Vertigo. Center: Otologic Carina™ cochlear implantation deployed within the inner ear. Right: EEG cap recording brain activity produced by electroencephalography.