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Introductory Chapter: Emotion and Attention Recognition Based on Biological Signals and Images

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Additional information is available at the end of the chapter

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1. Emotion and attention recognition based on biological signals and images

This chapter will attempt to introduce the different approaches for recognition of emotional and attentional states, from a historical development, focusing particularly on the recent development of the field and its specialization within psychology, cognitive neuroscience, and engineering. The basic idea of this book is to present a common framework for the neuroscientists from diverse backgrounds in the cognitive neuroscience to illustrate their theoretical and applied research findings in emotion, stress, and attention.

Biological signal processing and medical image processing have helped greatly in understanding the below-mentioned cognitive processes. Up to now, researchers and neuroscientists have studied continuously to improve the performances of the emotion and attention recognition systems (e.g., [1–10]). In spite of all of these efforts, there is still an abundance of scope for the additional researches in emotion and attention recognition based on biological signals and images. In the meantime, interpreting and modeling the notions of the brain activity, especially emotion and attention, through soft computing approaches is a challenging problem.

Emotions and attentions have an important role in our daily lives [11]. They definitely make life more challenging and interesting; however, they provide useful actions and functions that we seldom think about. Emotion and attention, due to its considerable influence on many brain activities, are important topics in the cognitive neurosciences, psychology, and biomedical engineering. These cognitive processes are core to human cognition and accessing it and being able to act have important applications ranging from basic science to applied science.

‘Emotion’ has many medical applications such as voice intonation, rehabilitation, autism, music therapy, and many engineering applications such as brain-computer interface (BCI),

human-computer interaction (HCI), facial expression, body languages, neurofeedback, marketing, law, and robotics. In addition, 'attention' has many medical applications such as rehabilitation, autism, attention deficit disorder (ADD), attention deficit hyperactivity disorder (ADHD), attention-seeking personality disorder, and many engineering applications such as BCI, neurofeedback, decision-making, learning, and robotics.

Up to now, different definitions have been presented for the emotion and attention. According to most researchers, attention phenomenon and emotion phenomenon are not well-defined words. Kleinginna and her colleagues collected and analyzed 92 different definitions of emotion, then they made a decision that "*emotion is a complex set of interactions among subjective and objective factors, mediated by neural or hormonal systems* [12]." In addition, Solso [13] said that attention is "*the concentration of mental effort on sensory/mental events.*" In another definition, the attention function is defined as "*a cognitive brain mechanism that enables one to process relevant inputs, thoughts, or actions, whilst ignoring irrelevant or distracting ones* [14]."

In different researches, suitable techniques are usually used according to invasive or noninvasive acquisition techniques. Invasive techniques often lead to efficient systems. However, they have inherent technical difficulties such as the risks associated with surgical implantation of electrodes, stricter ethical requirements, and the fact that in humans, this can only be done in patients undergoing surgery. Therefore, noninvasive techniques such as electroencephalography (EEG), magnetoencephalography (MEG), event-related potentials (ERPs), and functional magnetic resonance imaging (fMRI) are generally preferred.

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