Abstract

Cognitive loading is the amount of the resources of the brain used in cognitive tasks at a given moment. Increase in the cognitive loading causes cognitive fatigue which may lead to hazards. Eye movements provide a fair indication of the cognitive loading. Two conventional techniques to record eye movements are Electrooculography (EOG) and Video-oculography (VOG). However, there are some issues while developing EOG and VOG based frameworks to estimate the amount of cognitive loading. The challenges in developing an EOG-based analysis framework are the presence of baseline wander, noise, and artifacts, similarities in eye movement signatures, etc. Likewise, the VOG-based analysis offers challenges such as illumination variation, noisy image acquisition, head pose variation of the user, occlusion through spectacles, etc. This thesis reports the development of EOG and VOG based systems, thereby addressing most of such issues. The notable contributions of this thesis are the piecewise empirical mode Bayesian estimation (PEMBE) for denoising EOG, 1-D multiresolution descriptors *viz.* saclets and blinklets for the extraction of eye movement signatures, local spectral binary codes (LSBC) for multispectral image analysis, and specific neural networks for VOG analysis. We also report four databases to train and validate our frameworks. Finally, we implement the developed frameworks on portable embedded platforms to design two EOG-based and three VOG-based systems suited for specific applications.

Keywords: Cognitive Loading, Electrooculography, Videooculography, Convolutional Neural Networks, Portable Systems.