Abstract

Stress is a pervasive issue that has an effect on one's psychological and physiological health. While facial signatures may be used to identify the start of stress, thermal imaging is more effective than visual imaging in catching specific characteristics pertaining to stress. However, there are obstacles in the way of creating frameworks for stress evaluation based on thermography, which calls for focused and targeted research. This thesis addresses prevailing issues in stress estimation using thermal imaging. Addressing the main constraint of stress assessment, which is the limitation of open data sets available for research; specific databases are created for study. The databases are as follows: Heteroface for personality traits; Thermo-stress face database (TSFD) for geriatric stress; and Thermal Dataset of Lying Individuals (TDLI) for deception-induced stress. Three case studies are conducted on different human populations: 1) Assessing stress in the adult population with neurotic and extrovert personality characteristics using Eysenck's PEN model, employing hidden Markov models and support vector machines. 2) Estimating stress in the geriatric population through a translation of facial thermograms to vasculature imprint maps via a conditional Generative Adversarial Network (cGAN). 3) Investigating stress generation during deception using spatiotemporal facial heat maps on a developed TDLI. The results obtained exhibit the variation in stress manifestation in individuals with different personality traits. The research findings also demonstrate that spatio-temporal changes in facial thermograms vary across different populations and scenarios. Additionally, a framework for translating facial thermograms to vasculature imprints is proposed, named Facial Vasculature Imprint Network (FVINet). This thesis contributes to stress assessment methodologies by leveraging thermal imaging and machine learning techniques. The developed frameworks offer insights into stress manifestation in diverse scenarios and populations. Furthermore, the implementation of portable systems using readily available components enhances the practical

applicability of the proposed methodologies. Finally, the study also identifies multiple scopes for future research in the domain of stress estimation.
Keywords: Stress, Thermal Imaging, Vasculature Imprint, Personality, Emotion, Eigenface, Hidden Markov Model, cGAN, Thermal gradients