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Plenary Talk II

Measuring Student Engagement in Early Engineering Coursework

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Abstract

This talk describes recent efforts for quantifying students' engagement in early engineering coursework, through designing, implementing, and testing a system to measure the students' emotional, behavioral, and cognitive engagement states. Engineering programs suffer from a high rate of attrition in the freshman year, primarily due to poor engagement of students with their classes. The project plans to develop a sensor-driven, computational approach to measure emotional and behavioral components of student engagement. This information will be used to identify teaching strategies that increase engagement, with the goal of enhancing student success and retention in STEM education pathways. The project features a multi-disciplinary collaboration between faculty and undergraduate researchers in engineering, the physical sciences, psychological sciences, and education. The project involves students in first- and second-year engineering STEM subjects and the experienced faculty who teach these courses. Findings from the project could be a valuable step toward an early warning system to detect student disengagement and anxiety in STEM and non-STEM courses. Project goals include: (i) establishment of a robust network of non-obtrusive and non-invasive sensors in mid-size classes to enable real-time extraction of facial and vital signs, which will be integrated and displayed on instructors' dashboards; (ii) identification of robust descriptors for modeling the emotional and behavioral components of engagement using data collected by the sensor networks; (iii) pilot testing of the system's effectiveness in gathering meaningful data for subsequent work on emotional, behavioral, and cognitive metrics of engagement. The fundamental research question to be addressed relates to improving student learning by the automated capture of non-verbal cues of engagement: How can we use students' expressions of engagement, based on non-verbal signs such as facial expressions, body and eye movements, physiological reactions, posture, to enhance learning? Findings from the project will constitute a foundation for multi-disciplinary research to incorporate novel machine learning and artificial intelligence-based models for measuring engagement in STEM classes. This project has been funded by the National Science Foundation (NSF). The talk will describe our latest discoveries in this long-term and multidisciplinary project.

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Biography

Aly A. Farag Fellow, IEEE and IAPR received the bachelor degree in Electrical Engineering from Cairo University, Egypt and the PhD degree from Purdue University in Electrical Engineering. He also holds master degrees in biomedical engineering from the Ohio State University and the University of Michigan, Ann Arbor. He joined the University of Louisville in August 1990, where he is currently a Professor of Computer Science and Engineering (CSE), and Professor of Electrical and Computer Engineering (ECE). At the University of Louisville, Dr. Farag founded the Computer Vision and Image Processing Laboratory (CVIP Lab) which focuses on imaging science, computer vision and biomedical imaging. Dr. Farag main research focus is scene analysis, object reconstruction from multimodality imaging, statistical and variational methods for object modeling, and facial biometrics. He has authored over 400 technical papers, edited two volumes on Deformable Models for Biomedical Applications (Springer 2007). He is the author of two text books: Biomedical Image Analysis: Variational and Statistical Approaches – Cambridge University Press, 2014, and Introduction to Probability Theory with Engineering Application, Cognella, 2020. During the past 25 years, Dr. Farag has been principal investigator of a number of major projects funded by the NSF, DoD, NIH and industrial organizations in the United States. He introduced 13 subjects into the CSE and ECE curriculum, and has been member/chairperson of various departmental and college-wide committees. He graduated 34 MS and 26 PhD students, mentored 20 postdoctoral researchers, and currently advising 5 PhD, two MS, two postdoctoral scientists and several undergraduate student researchers, sponsored by the NSF REU program. He holds seven US patents on object modeling, computer-aided diagnosis, and visualization. Dr. Farag is a regular reviewer for the NSF and NIH, and various technical journals and international conferences. Dr. Farag was associate editor of the IEEE Transactions on Image Processing (2000—2004) and presently associate editor of the IET-CV British Journal. He was lead guest editor of IEEE Transactions on Information Forensics and Security Special Issue on Facial Biometrics in the Wild (December 2014). He is a guest editor for the Sensors Journal special issue on Optical Imaging, April 2021. He was co-general chair of the IEEE International Conference on Image Processing (ICIP'2009), and has been general chair of the International Conference on Multimedia Technology (ICMT'2011 and ICMT'2013). He received the University of Louisville top Research (1999) and Teaching awards (2009 and 2011); and the most prestigious Trustees Award in 2015. In 2002, he received university scholar designation. Dr. Farag is a regular reviewer to NSF and NIH study sections, the Ralph E. Powe Faculty Award, Research Council of Canada, The Czech Academy of Sciences, Qatar Research Funds and. Dr. Farag is a Fellow of the IEEE and IAPR and member of numerous professional organizations in the US and abroad.

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