



COLLEGE OF ENGINEERING
AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

“Incorporating Emotion Recognition in Co-Adaptive Systems”

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[Zoom](#)

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DEPARTMENT:

Electrical Engineering and Computer Science

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ABSTRACT OF DISSERTATION

Incorporating Emotion Recognition in Co-Adaptive Systems

The collaboration between human and computer systems has grown astronomically over the past few years. The ability of software systems adapting to human's input is critical in the symbiosis of human-system co-adaptation, where human and software-based systems work together in a close partnership to achieve synergetic goals. However, it is not always clear what kinds of human's input should be considered to enhance the effectiveness of human and system co-adaptation. To address this issue, this research describes an approach that focuses on incorporating human emotion to improve human-computer co-adaptation. The key idea is to provide a formal framework that incorporates human emotions as a foundation for explainability into co-adaptive systems, especially, how software systems recognize human emotions and adapt the system's behaviors accordingly. Detecting and recognizing optimum human emotion is a first step towards human and computer symbiosis. As the first step of this research, we conduct a comparative review for a number of technologies and methods for emotion recognition. Specifically, testing the detection accuracy of facial expression recognition of different cloud-services, algorithms, and methods.

Secondly, we study the application of emotion recognition within the areas of e-learning, robotics, and explainable artificial intelligence (XAI). We propose a formal framework that incorporates human emotions into an adaptive e-learning system, to create a more personalized learning experience for higher quality of learning outcomes. In addition, we propose a framework for a co-adaptive Emotional Support Robot. This human-centric framework adopts a reinforced learning approach where the system assesses its own emotional re-actions.

Finally, we present a formal probabilistic framework that incorporates emotion recognition for explanations and predicting human performance in a co-adaptive scenario. We illustrate the operability of our framework using a Decision Support System with a human operator supervising the system's decisions. We model our approach using a Stock Prediction Engine that was developed in our research lab to predict the price direction of a stock. We use probabilistic model checking to determine how complex an explanation needs to be based on how confused the human is for the purpose of improving the system's overall utility. In addition, we conduct a web-based human experiment to measure the effectiveness of incorporating emotions in improving the outcome of a co-adaptive system. Our study shows that considering human emotions in co-adaptive systems' explanation is one of the important factors for improving the overall systems performance and utility functions.

BIOGRAPHICAL SKETCH

Born in Riyadh, Saudi Arabia

B.S., King Faisal University, Al-Ahsa, Saudi Arabia, 2011

M.S., Claremont Graduate University, Claremont, California, 2016

Ph.D., Florida Atlantic University, Boca Raton, Florida, 2022

CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

Time in Preparation: 2016 - 2022

Qualifying Examination Passed: Spring 2017

Publications:

O. M. Al-Omair and S. Huang, "A Comparative Study on Detection Accuracy of Cloud- Based Emotion Recognition Services." In Proceedings of the 2018 International Conference on Signal Processing and Machine Learning (SPML '18), 2018, pp. 142-148. ACM.

O. M. Al-Omair and S. Huang, "A Comparative Study of Algorithms and Methods for Facial Expression Recognition." In 2019 IEEE International Systems Conference (SysCon), 2019, pp. 1-6.

O. M. Al-Omair and S. Huang, "An Emotionally Adaptive Framework for E-Learning Systems." In 2019 2nd International Conference on Computer Applications & Information Security (ICCAIS'2019), 2019. pp. 1-6. IEEE.

O. M. Al-Omair and S. Huang, "An Emotional Support Robot Framework using Emotion Recognition as Nonverbal Communication for Human-Robot Co-Adaptation." FTC 2022 - Future Technologies Conference 2022 (Under Review)

O. M. Al-Omair and S. Huang, "A Probabilistic Model for Incorporating Human Emotion for Explainability in Co-Adaptive Systems." ACM Transactions Interactive Intelligent Systems (Under Review)