PennState

NSF-NRI 1527148

Real Time Observation, Inference and Intervention of Co-robot Systems Towards Individually Customized Performance Feedback Based on Students' Affective States

Christian E. López[1] & Dr. Conrad S. Tucker(Principal Investigator)[1,2]

[1]Department of Industrial and Manufacturing Engineering,
[2]School of Engineering Design Technology and Professional Programs
The Pennsylvania State University, University Park

Dr. Timothy Brick (Co-PI)

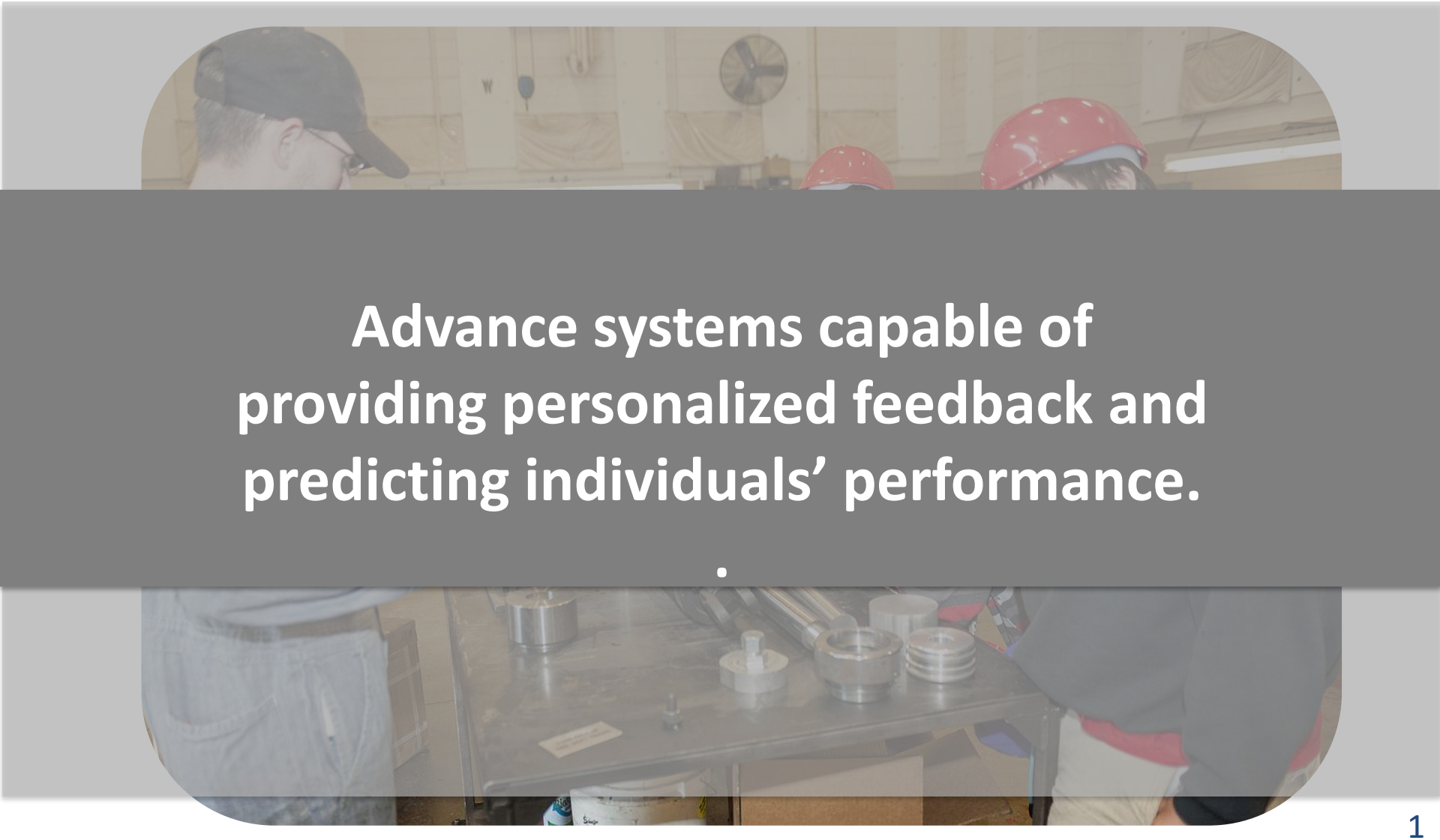
Department of Health and Human Development,
The Pennsylvania State University, University Park

Grand Engineering Challenges of the 21st century: *Development of Personalized Learning*

[Vest 2008]

Grand Engineering Challenges of the 21st century: *Development of Personalized Learning*

[Vest 2008]

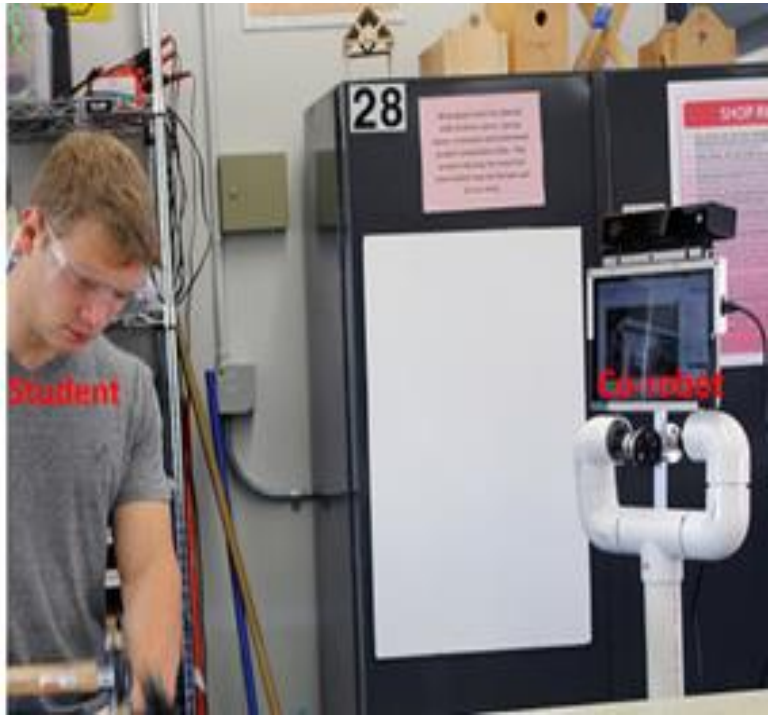


Advance systems capable of providing personalized feedback and predicting individuals' performance.

.

Researchers are starting to implement intelligent system technology (e.g., Robots) in educational settings [Mubin *et al*., 2013]

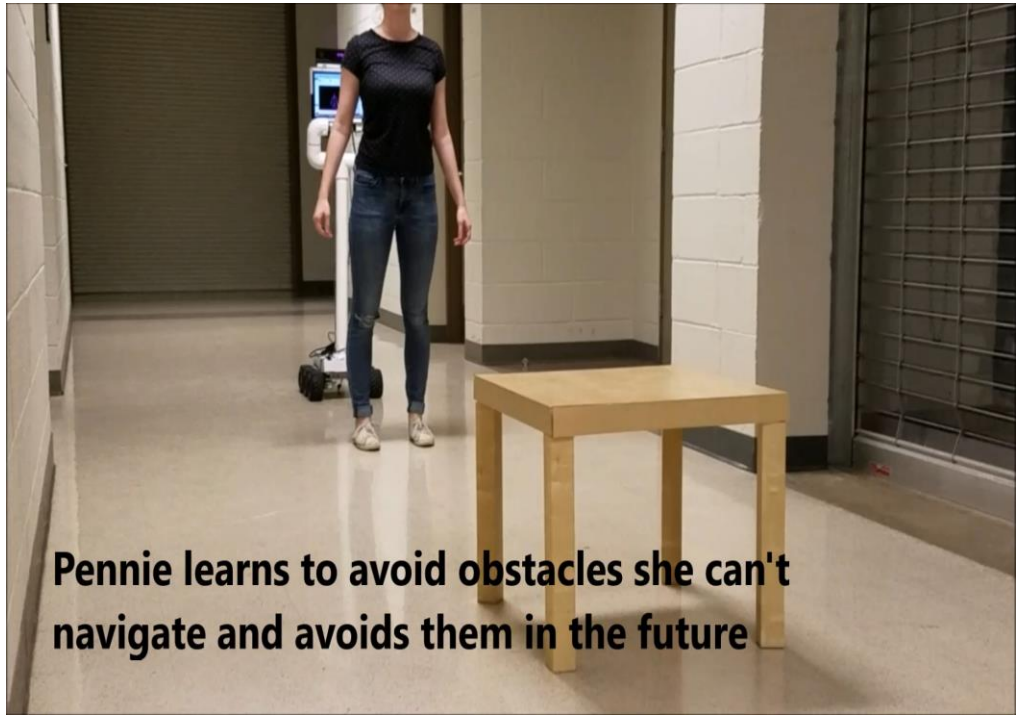
*Collaborative Robots (**Co-Robots**): are a class of robots that work in collaboration with humans towards the successful completion of a task.*

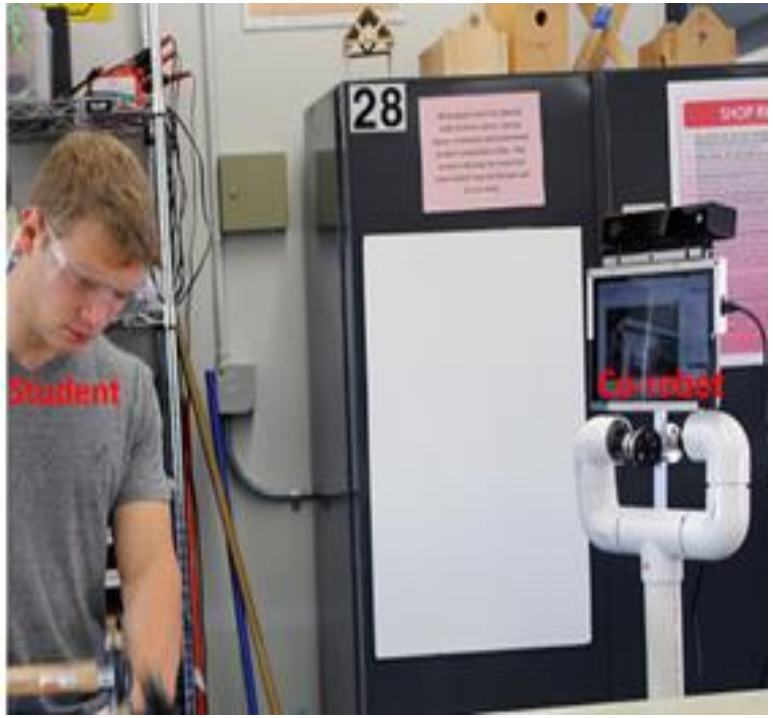


[Lopez & Tucker, 2017]

Researchers are starting to implement intelligent system technology (e.g., Robots) in educational settings [Mubin *et al*., 2013]

*Collaborative Robots (**Co-Robots**): are a class of robots that work in collaboration with humans towards the successful completion of a task.*





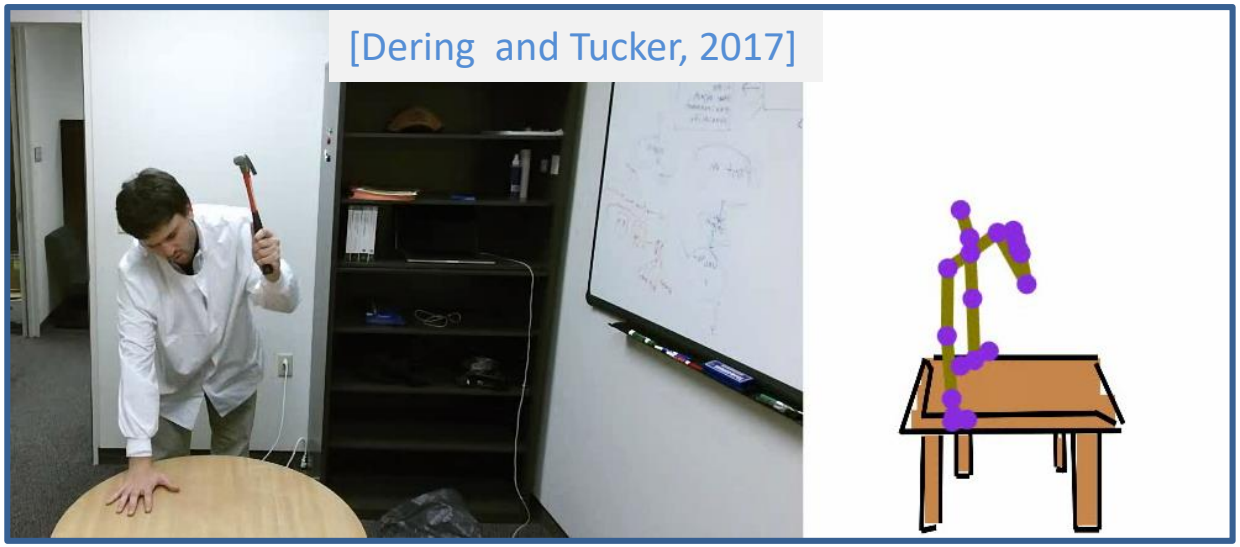
[Lopez & Tucker, 2017]

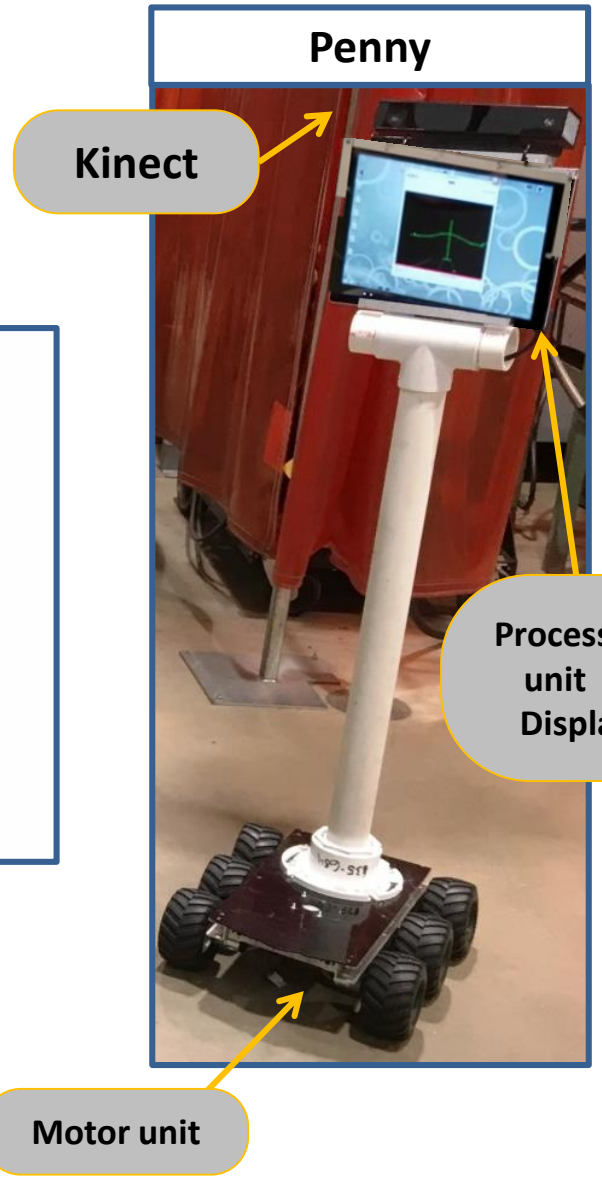
The Co-robot is capable of capturing Image and Depth Data to provide real-time feedback

Real-Time Feedback: **For Safety**

The Co-robot is capable of capturing Skeletal Data to provide real-time feedback

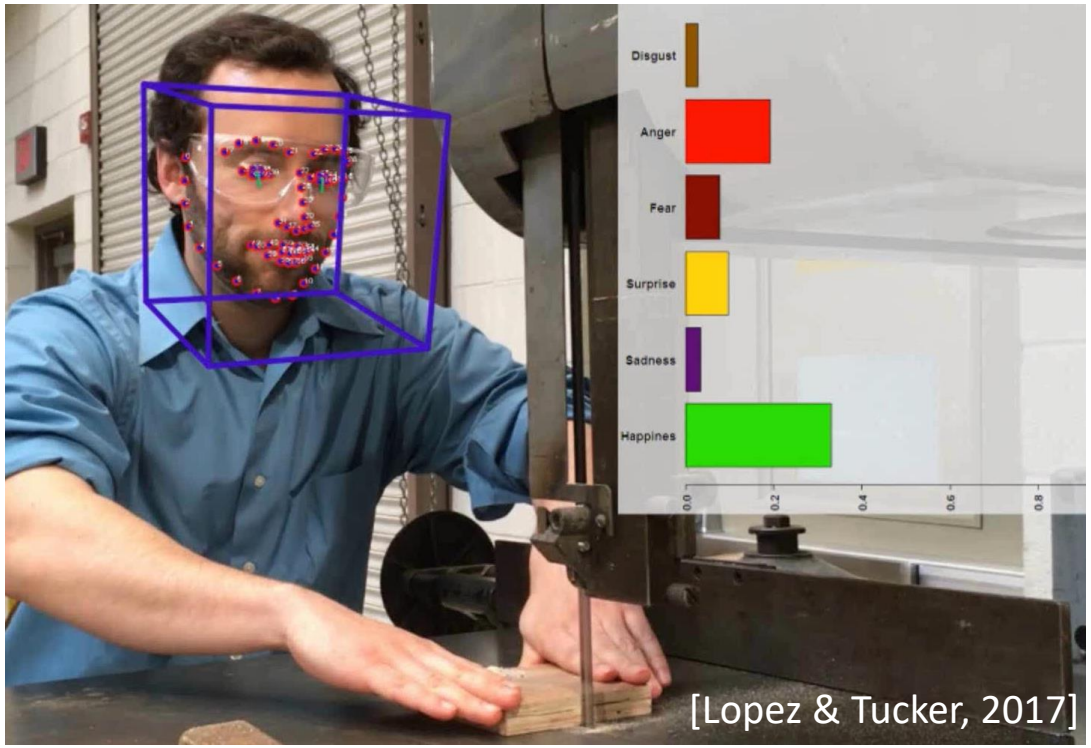
Real-Time Feedback**: Task Performance**



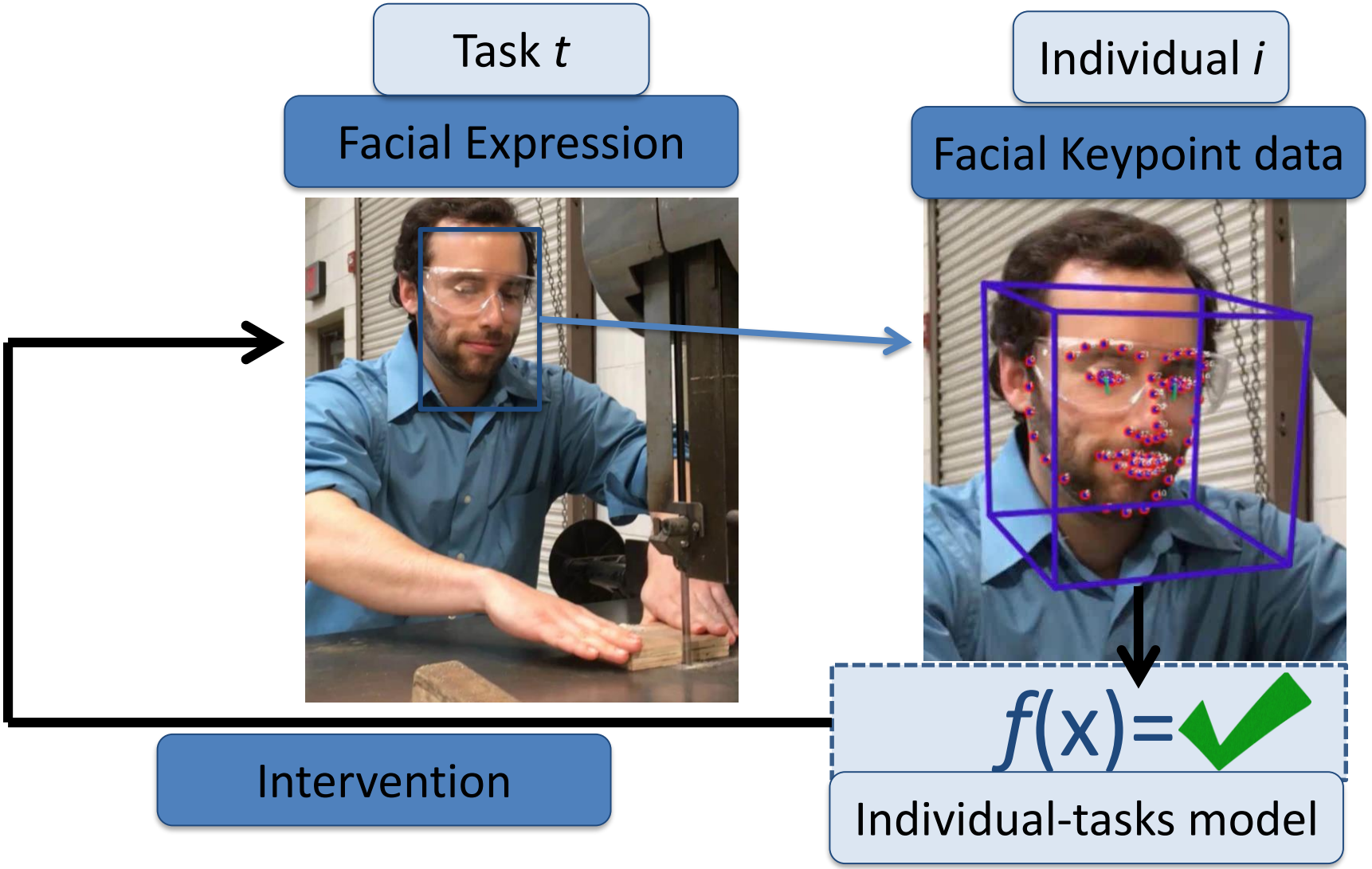


The Co-robot is capable of capturing Facial Expressions Data to provide real-time feedback

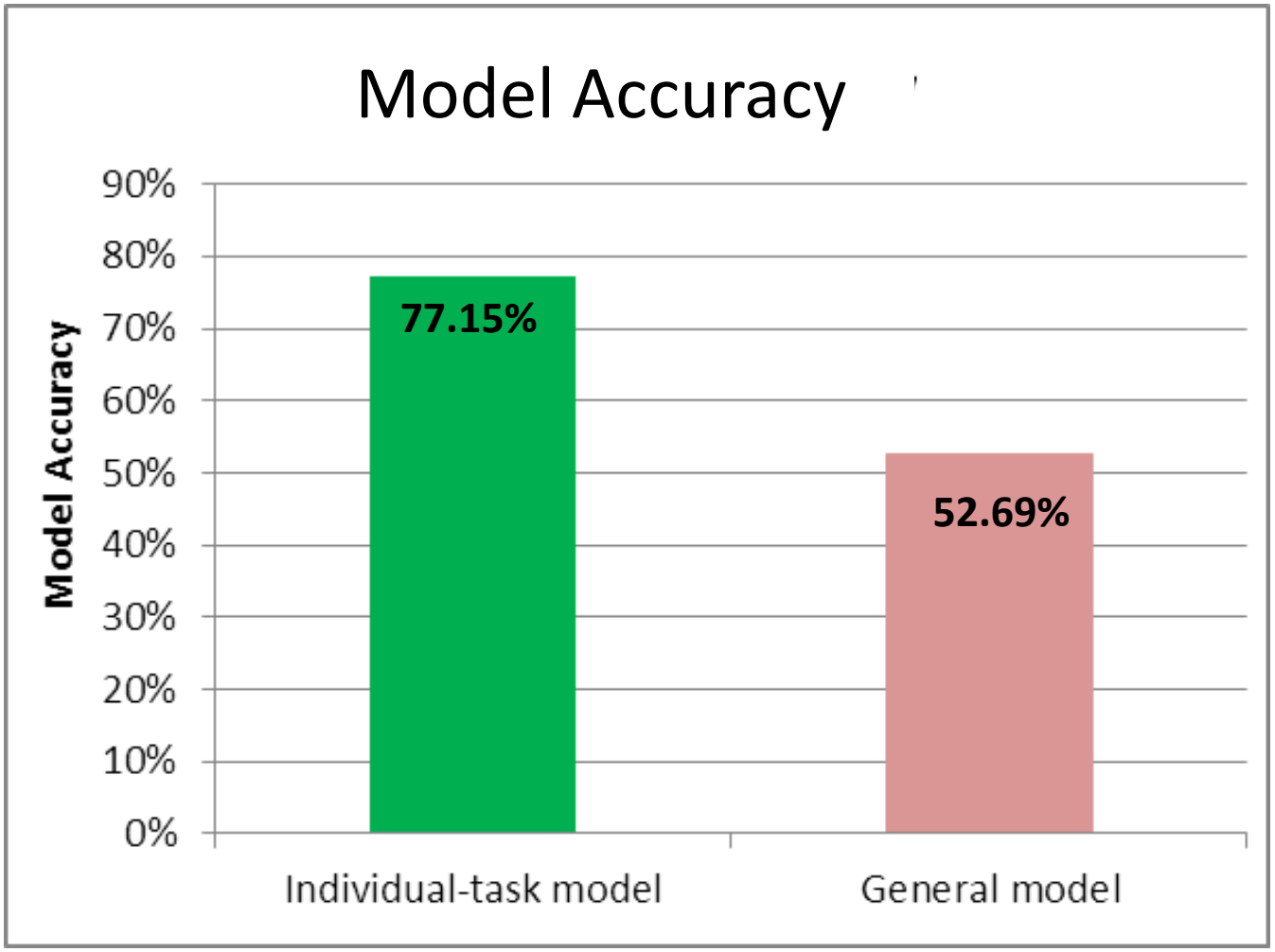
Real-Time Feedback:
Performance Prediction



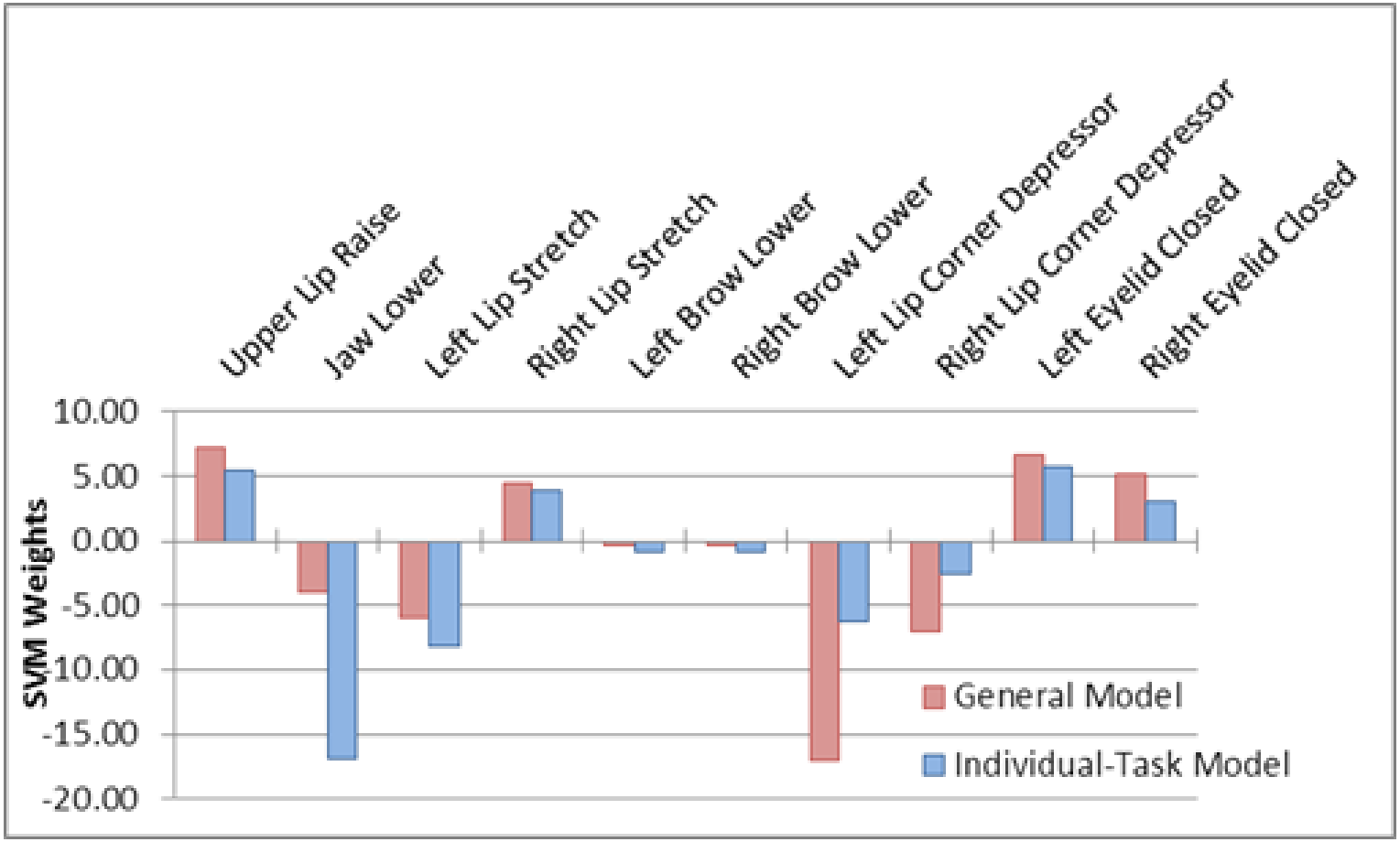
The proposed i*ndividual-task* model takes into consideration tasks and individual differences.



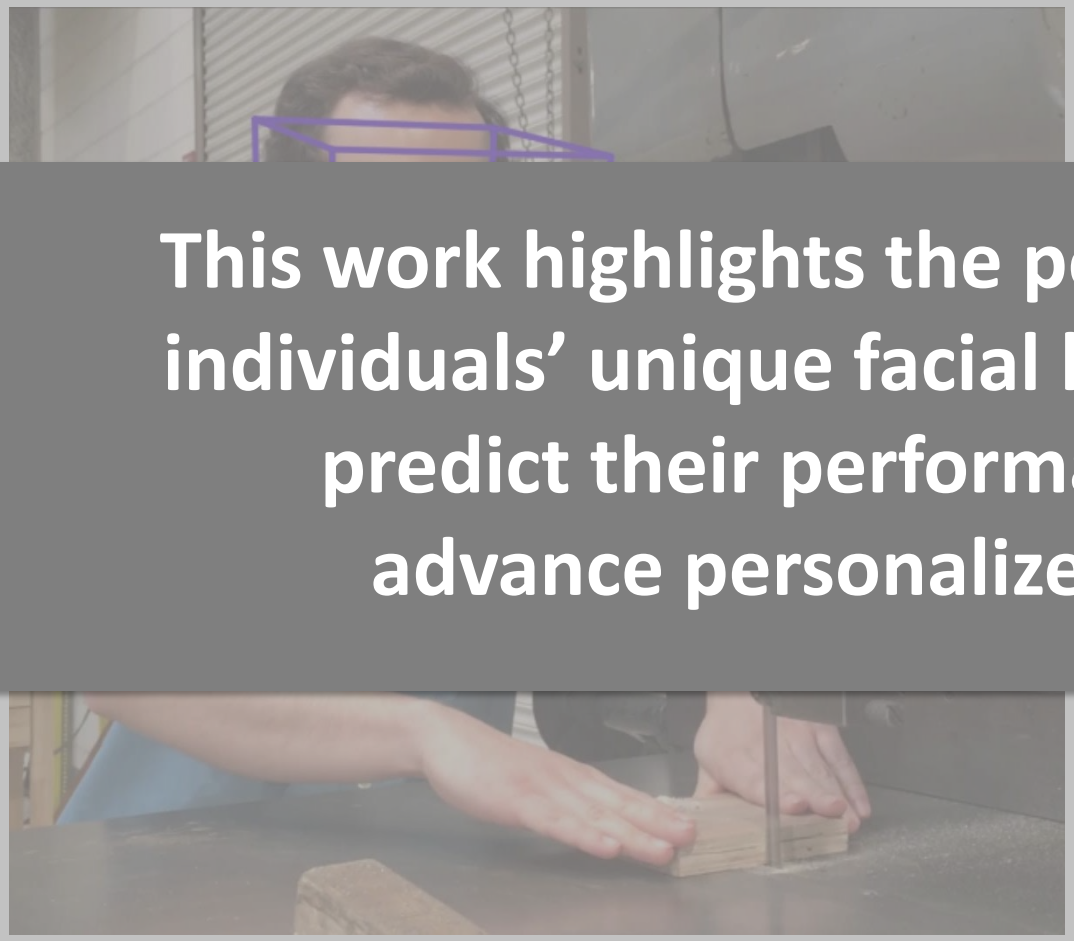
Results and Discussion:
***Individual-tasks* model outperform the *General* model**



Results and Discussion:
Some Facial Keypoints play a more central role



Limitation and Future Works:
Time evolution of Facial Keypoints and different tasks.



This work highlights the potential of using individuals' unique facial keypoint data to predict their performance and to advance personalized systems

PennState

D.A.T.A.
Design Analysis
Technology Advancement Laboratory

Thank you!

This research is funded in part by NSF NRI # 1527148. Any opinions, findings, or conclusions found in this paper are those of the authors and do not necessarily reflect the National Science Foundation.

References

Dering, M., and Tucker, C. (2017), "A Convolutional Neural Network Model for Predicting a Product's Function, Given Its Form", ASME Journal of Mechanical Design, DOI:10.1115/1.4037309

Dering, M., and Tucker, C., "Implications of Generative Models in Government", AAAI 2017 Fall Symposium Series, Washington, D.C., November 2017

Bezawada, S., Hu, Q., Gray, A., Brick, T., and Tucker, C. (2017), "Automatic Facial Feature Extraction for Predicting Designers' Comfort With Engineering Equipment During Prototype Creation," J. Mech. Des., **139**(2), p. 21102.

Dering, M., Tucker C., and Kumara, S. (2017), "An Unsupervised Machine Learning Approach To Assessing Designer Performance During Physical Prototyping", *ASME J Comput Inf Sci Eng*. 2017

Lopez C, and Tucker C., (2017), "When to Provide Feedback? Exploring Human-Co-Robot Interactions in Engineering Environments", In: *ASEE Annual Conference & Exposition*. Columbus, OH; 2017.

Mohammed, A., Viola, T., Tucker, C., and Duarte, J. (2016), "Towards Co-Robot Navigation in Manufacturing Environments through Machine Learning of Human Movement Patterns", 2016 International Conference on Sustainable Smart Manufacturing (S2M).

Behoora, I., and Tucker, C. (2015), "Machine learning classification of design team members' body language patterns for real time emotional state detection," Des. Stud., **39**, pp. 100–127.