Callyn I. Villanueva

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Github

SUMMARY

I build devices—sometimes including robots—to explore human perception and interaction with autonomous systems. My goal is to deepen our understanding of human behavior in dynamic, technology-driven environments. Currently, I am a high school Computer Science educator and co-leader of a robotics program.

INTERESTS

Signal processing, human-(computer/robotic) interaction, affective computing.

ACADEMIC BACKGROUND

M.S. Computer Science (Distinction) 2020
New York Institute of Technology, New York, NY
- Research in Affective Computing under direction of Dr. Houwei Cao. Thesis title: Analysis of Eye Fixations During Emotion Recognition in Talking Faces
- Graduate Mentor Dr. Sandra Kopecky

B.A Psychology, Cognitive Science 2015
Hofstra University, Hempstead,NY
- Focus Areas: Psychology, Linguistics, Neuroscience (Project: Impaired Cognitive Process in Attention Deficits)
- Undergrad Research Mentor Dr. Jin Shin

RESEARCH

Intern Fall 2021
Quantitative Neuroimaging Lab, Weill Cornell Medicine
- Acquired foundational knowledge in utilizing neuroimaging software tools, including Freesurfer and FSL, for cortical surface reconstruction from MRI to investigate negative BOLD response (NBR)

Graduate Research Assistant Jan 2020 - May 2021
Human-Centric Data Analytics Lab, New York Institute of Technology
- Collected real-time eye fixation data using the Tobii Pro Software eye tracking system, ensuring precise and accurate measurements.
- Implemented a new approach to analyzing emotional perception & gaze fixation by grouping selected audio & visual stimuli from the (CREMA-D) dataset

TEACHING

HS Technology Instructor & Developer Present
Grace Church School, New York, NY
- Together with Dr. Akbar Herndon, we continuously improve curriculum materials for technology courses (Harvard CS50, Digital Tools & Citizenship), ensuring alignment with academic objectives.
- FIRST Robotics Coach - Assisting high school team members with writing code to control robot in FTC Onbot JAVA in preparation for Qualifiers

Subject Expert Teacher July 2022 - May 2023
BASIS Independent Brooklyn, Brooklyn, NY

- Middle & high school (grades 7-12) computer science teacher specializing in computer programming instruction, particularly in introductory college-level courses. Courses Taught: *AP CS A, AP CS Principles, Intro to Python Programming & Scratch*

- Mentored HS Student River (Rohan) W. on several ML projects such as: Building Neural-Network from scratch(Using Numpy package) & sentiment-driven stock price prediction using news API.

Graduate Teaching Assistant   Sep 2019 - Dec 2020
New York Institute of Technology, New York, NY
- Assisted teaching undergraduate level computer science courses with Dr. Wenjia Li, averaging over 60+ students. Courses Taught: *Computer Programming II (CSCI 185 - OOP with Java), Computer Programming Concepts (CSCI 318)*

NOTABLE PROJECTS

BUBBLE-BOI   In Progress*

- Currently developing a small, autonomous robot capable of blowing bubbles using the Tiva Series Launchpad microcontroller. Designed and implemented motor control, bubble blowing mechanisms, and tweaking sensor-based navigation to create an interactive experience.

Chroma-Chords (TinyML)   Project Link

- By training the Arduino Nano 33 BLE Sense with the GTZAN dataset of audio samples, the system accurately classifies music into various genres in real-time and provides user experience through dynamic LED color display. Model deployed as a C++ library

SPECIAL ACHIEVEMENTS

Awards
- *Computer Science Graduate Achievment Award* College of Engineering & Computing Science, New York Institute of Technology, 2020

- *Undergraduate Research Presentation Award*, SUNY Farmingdale, 2015

SKILLSET

- Research: User Evaluations (Statistical analysis, Methodologies & Design, Interviews).

- Languages & Frameworks: Python, C/C++, TensorFlow, PyTorch, Keras, OpenCV, R Robot Operating System (ROS), Linux (Bash Scripting)

- Electronics and Hardware Programming Experience in hardware-oriented software development: Arduino, Raspberry Pi, ARM Cortex-M4F-based micro controller.

Statement of Purpose
of Callyn Villanueva (CS PhD for Fall 2025)

My objective is to pursue a Ph.D. in Computer Science, focusing on developing systems that range from computer-aided technology to human-robot interaction. I am particularly interested in creating innovative solutions for exceptional individuals facing challenges in communication, motivation, and emotion regulation, while also enabling robots and computers to respond intelligently to natural human feedback.

My motivation to pursue a Ph.D. is largely based on my accumulated research experience in the multidisciplinary fields of Computer Science, Engineering, and Psychology. This includes working under Dr. Houwei Cao in the Human-Centric Data Analytics Lab and collaborating with Dr. Jin Shin during my Senior Research Project. I have also worked alongside with notable professors in their projects (Dr. Sandra Kopecky - Lecturer at NYIT & Pace University along with Dr. Razlighi in the Quantitative Neuroimaging Lab). These ventures into serious research over the past few years have affirmed my passion for technical projects.

During my time at the Human-Centric Data Analytics Lab, I addressed questions surrounding how humans perceive emotion based on facial expressions and how this perception influences their overall understanding of emotional communication. In a pilot study titled *Analysis of Eye Fixations During Emotion Recognition in Talking Faces*, I developed a novel approach to analyzing emotional expressions by categorizing audio and video data from the CREMA-D dataset into three distinct groups: Congruent, Incongruent, and Synthetic. This methodology allowed for a more nuanced examination of how eye fixations interact with and respond to different emotional cues in multimodal stimuli. This work addresses a significant gap in research on emotion recognition, as traditional studies often focused on facial or vocal cues in isolation, overlooking the complex interplay between these cues in real-world communication. By working on this innovative approach, I aimed to enhance our understanding of how individuals process and interpret emotional information when facial and vocal cues either align or conflict.

Additionally, we propose to develop a novel emotion perception classifier that can automatically classify an observer's emotional perception based on their gaze patterns and fixation sequences while identifying basic emotions in expressive talking faces. The proposed models achieved an overall classification accuracy of 84.1 (percent) in recognizing three categories of emotions: negative, positive, and neutral. These findings suggest that the fixation time on the selected AOIs

holds significant promise for the automatic classification of perceived emotions

I have also worked on a project with Dr. Kopecky along with a research colleague, Christian Oliveto, aimed at developing a deep learning-based system for analyzing eye tracking data to assist in the early diagnosis of autism spectrum disorder (ASD). This innovative system was trained on a comprehensive dataset of eye tracking recordings from both individuals with ASD and neurotypical individuals, enabling it to learn patterns associated with ASD-related gaze behaviors. Preliminary results have shown that the Sequential FNN model achieved high accuracy for both the training and validation datasets. In addition to classification accuracy, ANOVA tests conducted on various eye tracking metrics revealed significant differences between individuals with ASD, neurotypical individuals, and those labeled as Unidentified.

In 2019, I had the opportunity to work as a graduate teaching assistant under the guidance of Dr. Wenjia Li. During this time, I had the privilege of instructing several undergraduate courses, including CSCI 125 (Computer Programming I), CSCI 185 (Computer Programming II), and CSCI318 (Programming Language Concepts), each centered around Java programming. In the Spring of 2022, I extended my teaching journey to encompass middle and high school computer science. This opportunity enabled me to introduce young minds to the world of programming, guiding them through foundational courses and mentoring high school students. In essence, my role as an educator extends beyond the dissemination of information. Alongside with research, I am committed to nurturing a new generation of computer scientists who possess not only technical expertise but also the ability to innovate and adapt in an ever-evolving field.

In conclusion, the findings and approaches I have explored throughout my research journey have solidified my commitment to finding innovative solutions using computer- aided technology and robotics. My goal is to develop systems that not only enhance understanding and diagnosis of conditions like autism spectrum disorder but also empower individuals to navigate the world more effectively. If I pursue my Ph.D. studies at Columbia University's School of Engineering & Applied Science, I aim to leverage advancements in deep learning and human-computer interaction to create adaptive technologies that promote emotional and social engagement. I am excited about the potential to transform lives through research that bridges the gap between technology and human experience.

Although I do not yet have publications, my experience in conducting high-level research has

Statement of Purpose
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equipped me with a strong foundation in the methodologies and ethical considerations essential for impactful inquiry. I'm currently drawn to several research initiatives at Columbia, including the Computer-Enabled Abilities Laboratory (CEAL) under the direction of Brian Smith, Zhou Yu's Lab, which focuses on human-machine communication, and the Robotics and Embodied Artificial Intelligence Lab led by Shuran Song. I am committed to contributing to a vibrant academic community at Columbia that prioritizes innovation and inclusivity in technology.