

# Chris Smith Crawford Jr.

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## EDUCATION

Ph.D. in Human-Centered Computing

GEM Fellow

Advisor: Dr. Juan E. Gilbert

University of Florida, Gainesville, FL

B.S. in Computer Science

University of Alabama, Tuscaloosa, AL

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## RESEARCH INTERESTS

Brain-Computer Interface (BCI), Human-Robot Interaction (HRI), Human-Computer Interaction (HCI),

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## RESEARCH STATEMENT

My work focuses on Brain-Computer Interfaces (BCI) and Human-Robot Interaction (HRI). My goal is to leverage novel neurophysiological sensing technologies, software engineering, and robotics to create tools and applications that support the exploration of Brain-Robot Interaction (BRI). I use a combination of Human-Computer Interaction (HCI) and BCI research to investigate how users interact with systems capable of adapting to their cognitive state.

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## PUBLICATIONS

### Journals

- J.1.** Andujar, M., Crawford, C. S., Nijholt, A., Jackson, F., & Gilbert, J. E. (2015). **Artistic brain-computer interfaces: the expression and stimulation of the user's affective state.** *Brain-Computer Interfaces*, 2(2-3), pp. 60–69.

### Conference Papers (Refereed)

- C.1.** Crawford, C.S. & Gilbert, J.E. (2017). **Neurophysiological Heat Maps for Human-Robot Interaction Evaluation.** 2015 AAAI Fall Symposium Series. Status: Accepted.
- C.2.** Crawford, C.S. & Gilbert, J.E. (2017). **NeuroBlock: A Block-Based Programming Approach to Neurofeedback Application Development.** *Visual Languages and Human-Centric Computing 2017*. Status: Accepted.
- C.3.** Lieblein, R., Hunter, C., Garcia, S., Andujar, M., Crawford, C. S., & Gilbert, J. E. (2017). **NeuroSnap: Expressing the User's Affective State with Facial Filters.** In *International Conference on Augmented Cognition* (pp. 345-353). Springer, Cham.
- C.4.** Crawford, C.S., Andujar, M., Jackson, F., Applrys, I., & Gilbert, J.E. (2016). **Using a Visual Programming Language to Interact with Visualizations of Electroencephalography Signals.** In *Proceedings of the 2016 American Society for Engineering Education Southeastern Section (ASEE SE)*, Tuscaloosa, AL, March 13-15, 2016.
- C.5.** Crawford, C.S., Badea, C., Bailey, S.W., & Gilbert, J.E. (2015). **Using Cr-Y Components to Detect Tongue Protrusion Gestures.** In *Proceedings of the 33rd Annual ACM CHI 2015 Conference Extended Abstracts*, pp. 1331-1336, Seoul, Republic of Korea, April 18-23, 2015.
- C.6.** Crawford, C.S. & Gilbert, J.E. (2015). **Towards Analyzing Cooperative Brain-Robot Interfaces Through Affective and Subjective Data.** In *Proceedings of the 10<sup>th</sup> Annual ACM/IEEE International Conference on Human-Robot Interaction Extended Abstracts* pp. 231-232. 2015.
- C.7.** Crawford, C.S., Andujar, M., Jackson, F., Remy, S., & Gilbert, J.E. (2015). **User Experience Evaluation Towards Cooperative Brain-Robot Interaction,** In *Proceedings 17th International Conference Human-Computer Interaction: Design and Evaluation, HCI International 2015*, pp. 184–193, Los Angeles, CA, August 2-

7, 2015, M. Kurosu (Ed.): Human-Computer Interaction, Part I, Springer LNCS 9169, DOI: 10.1007/978-3-319-20901-2\_17.

- C.8.** Crawford, C.S., Mack, N., Eugene, W., & Gilbert, J.E. (2015). **Televoting: Secure, Overseas Voting**, In Proceedings 3rd International Conference Human Aspects of Information Security, Privacy, and Trust HCI International 2015, pp. 487–494, Los Angeles, CA, August 2-7, 2015, T. Tryfonas and I. Askoxylakis (Eds.): HAS 2015, Springer LNCS 9190, DOI: 10.1007/978-3-319-20376-8\_43.
- C.9.** Dawson, S., Crawford, C.S., Dillon, E. & Anderson, M. (2015). **Affecting operator trust in intelligent multirobot surveillance systems**. In Robotics and Automation (ICRA), IEEE International Conference, pp. 3298-3304.
- C.10.** Crawford, C.S., Andujar M., Remy S., & Gilbert, J.E. (2014). **Cloud Infrastructure for Mind-Machine Interface**, In Proceedings on the International Conference on Artificial Intelligence (ICAI), pp. 127-133.
- C.11.** Dawson, S., Crawford, C., Dillon, E. & Anderson, M. (2012). **Examining the Expectations of Autonomy and Human Intervention in a Multi-robot Surveillance Task**, 50th Southeast Regional ACM Conference, Tuscaloosa AL, March 2012.
- C.12.** Anderson, Monica., Crawford, C.S., Kilgo, P. and Stanforth, M. (2011). **Work in Progress: Enabling robot device discovery through robot device descriptions**, 2nd International Workshop on Domain-Specific Languages and models for ROBotic systems, San Francisco, CA, USA, September 2011.

#### Conference Papers (Invited)

- C.13.** Andujar, M., Garcia, S., Lieblein, R., Cerillo, N., Crawford, C.S., Hunter, C., Gilbert, J.E. (2017). **NeuroSnap: Expressing User’s Affective State with Facial Filters**. HCI International 2017. Status: Accepted.

#### Book Chapters

- BC.1** Andujar, M., Nijholt, A., Crawford, C., & Gilbert J.E. (2017). **Measuring Affective Engagement with Brain-Computer Interfaces from a Human-Computer Interaction Perspective**. Brain-Computer Interface Handbook, Status: Under Review.

#### Invited Talks

- IT.1.** “**Brain-Robot Interaction & Applying Block-Based Programming to Neurofeedback Application Development**”, Computer Science Department Colloquium Series, University of Alabama, Tuscaloosa, Alabama, 2016
- IT.2.** “**Brain-Robot Interaction & Applying Block-Based Programming to Neurofeedback Application Development**”, Computer Science Department Colloquium Series, University of Alabama, Tuscaloosa, Alabama, 2017
- IT.3.** “**Neural Methods of Brain-Robot Interaction**”, ISTEAM Seminar Series, University of Florida, Gainesville, Florida, 2016

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#### WORK EXPERIENCE/INTERNSHIPS

[Assistant Professor at [the University of Alabama](#)] Department of Computer Science (8/16/2017)

[Perceptual Interface Intern at [Intel](#)] Software Engineering (05/5 – 08/8, 2014)

- Implemented additional functionality to perceptual computing application.
- Developed web based tool used to visualize accelerometer data using Amazon Kinesis. (Presented at Amazon Web Services Reinvent 2014).

### [HTML5/Node.js Software Engineering Intern at Intel] Software Engineering (05/20 – 08/30, 2013)

- Developed real-time analysis software tool that uses Ace Editor API, Node.js, jQuery, and HTML5.

### [Technical Architect at Ubind] Software Engineering (05/2010 – 01/2015)

- Consulted Ubind business development team on overall architecture helping to streamline the technical design and development process.
- Constructed Ubind's Drupal platform as well as the company's overall infrastructure, also configured the MySQL database and Apache server within Linux.
- Utilized SQLyog to manage and synchronize multiple databases.

### [Software Developer at SeniorGeek Communications, LLC] Software Engineering (05/2013 – 08/2016)

- Lead design and development of an entertainment mobile application (iOS, Android) that received ~12,000 downloads between August and October 2015.
- Designed a software application that provides mobile real-time location based video communication solutions.

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### Funding

Andujar, A., Crawford, C., Jackson, F. & Gilbert, J.E., Brain-Computer Interface Research & Development, Intel Corp., 8/15/2015 – 8/14/2017, \$300,000.

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### CURRENT RESEARCH PROJECTS

#### [Project Team Lead] Applying Block-Based Programming to Neurofeedback Application Development

**About:** Researching novel ways of designing an intuitive and robust BCI software platform that leverages block-based programming.

**Duties:**

- Designing, implementing and evaluating system that utilizes visual programming for BCI application development.

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### PAST RESEARCH PROJECTS

#### [Project Co-Lead] Brain-Drone Race, University of Florida

**About:** A competition featuring users' cognitive ability and mental endurance. During this event competitors are required to out-focus opponents in a drone drag race fueled by electrical signals emitted from the brain. (<http://braindronerace.com/>)

(<https://www.youtube.com/watch?v=hLjxMjBIB9k>)

**Duties:**

- Designed and developed a web-based system that managed neural control of multiple robots, stored completion times, and provided referees with an emergency top feature via a web-app.
- Developed computer vision technique using OpenCV that insured drones stayed inbounds during competition.

#### [Project Co-Lead] Brain-Robot Interaction: Mind-Machine Control Over the Web, University of Florida

**About:** A method to control machines (e.g. drones, humanoids, etc.) over the web with cognitive commands from the user. The idea is to provide flexibility for users to control machines located at their home while they are on the go.

**Duties:**

- Designing and developing Brain-Robot Interaction systems using web communication technologies such as Websockets along with using various BCI and Robot API's.
- Assisting with the design and facilitation of user studies, performing literature reviews, and writing research papers.

#### [Project Lead] Gesture & Physiological Driven Visualization, University of Florida

**About:** Researching novel ways of displaying visualization in real time based on motion and physiological data

**Duties:**

- Developed system that produces dynamic visualizations based on accelerometer data
- Assisted with the user interface design that provides visual feedback to users
- Integrated Amazon Kinesis into backend system to capture real-time accelerometer data streaming from multiple smart phones

#### [Project Lead] Televoting: An Alternative Approach to Internet Voting for Deployed Military Personnel, University of Florida

**About:** Developing system that allows military and overseas voters to cast a ballot privately. By coupling live video streaming technology with a secure ballot submitting process, Televoting presents a voting alternative that avoids many of the factors that are responsible for rejected and uncounted ballots.

**Duties:**

- Developing an online voting system, which uses IP cameras, web cameras, Wowza media server, and other web communication technologies.

**[Undergraduate Researcher]** ARTSI Workshop in a Box: Turnkey solution for providing robotics workshops to middle and high school students, University of Alabama

**About:** Research aimed at developing a single point resource for those getting started in robotics outreach. Studies and software development was focused on creating effective materials that are accessible to those who may have limited knowledge of robotics or limited experience in middle school outreach.

**Duties:**

- Developed educational software using Finch robot and HTML 5 WebSocket server technology that enables instructors to easily perform a robotics workshop within the Chrome browser.
- Assisted with collecting and analyzing data collected from k-12 participants.

**[Project Team Member, Software Developer]** Multi-robot surveillance simulation: Expectations of autonomy and human intervention in a multi-robot surveillance task, University of Alabama

**About:** Research investigated several approaches for cooperative surveillance using multiple UAVs. The primary goal of this study was to discover whether an autonomous, semi-autonomous, or manual system perform better for surveillance tasks.

**Duties:**

- Designed and developed robot simulation environment and models using Webots.
- Developed client-server system that managed communication between the robot simulation and an iPad.
- Assisted with designing and conducting studies using NASA-TLX and 3D SART, which measured workload and situational awareness. Also measured user trust, usability, and performance during this study.

**[Undergraduate Researcher]** Extending support for the Calliope robot to Player/Stage, University of Alabama

**About:** Prior to this project the Calliope robot only was supported in the robot platform Tekkotsu. Development was completed to extend support for Calliope to Player, a popular robot control interface.

**Duties:**

- Constructed robotic arm system using multiple actuators and a pan, tilt, zoom camera.
- Developed Player device driver for the robot.
- Conducted tests with robot by completing various manipulation tasks with robotic arm.

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## PAST TEACHING EXPERIENCE

**[Web Development Instructor at Clemson University, School of Computing]** Teaching Assistant (08/5 – 12/4, 2012)

- Taught a semester-long section (~19 students) of an introductory web development course lab.
- Responsible for preparing and presenting supplementary lectures and grading

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## Service

- **[Program Committee]** 2<sup>nd</sup> Block and Beyond VL/HCC Workshop (2017)
- **[Reviewer]** Human-Robot Interaction (HRI), ACM International Conference (2016)
- **[Reviewer]** Conference on Human Factors in Computer Systems (CHI), ACM International Conference (2016)
- **[Program Committee]** 11<sup>th</sup> International Conference, Human-Robot Interaction International Pioneers Workshop (2016)
- **[Book Reviewer]** Learning JavaScript Robotics, Cassandra Perch (2015)
- **[Lead Instructor]** CodeIT Day STEM engagement outreach program
  - Taught MakeMakey Course, Clemson, SC (2013)
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  - Taught NAO Robot Course, Gainesville, FL (2015)
- **[Mentor]** Helped develop the University of Alabama's Boys and Girls Club virtual mentoring program (2015)
- **[Lead Instructor]** Eastside High School Hour of Code (2015)
  - Taught Scratch course, Gainesville, FL (2015)
- **[Reviewer]** Intelligent Robots and Systems (IROS), IEEE/RSJ International Conference (2012)
- **[Instructor]** Finch robot outreach
  - Taught course on programming finch robot using web based educational software I developed (2011)

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## PROFESSIONAL ORGANIZATIONS

**Student Member**

- Brain-Computer Interface Society 2016 – Present
- Phi Kappa Phi Honor Society 2014 – Present
- Human-Factors and Ergonomics Society (HFES) 2012 – Present
- Institute of Electrical and Electronics Engineers (IEEE) 2012 – Present
- National Society of Black Engineers (NSBE) 2008 – Present
- Association for Computing Machinery (ACM) 2008 – Present