Katherine Ann Scott
Curriculum Vitae

Contact Information	Katherine Ann Scott 1701 Dexter Ave. Ann Arbor, MI, 48103 USA katherine.a.scott@gmail.com	*Voice:* (734) 358-0175 *Web:* www.kscottz.com *Twitter:* @kscottz *Github:* kscottz

Research Interests

Computer vision, augmented reality, active vision systems, single and multiple instance object recognition, 3D reconstruction from video, and robotics.

Education

Columbia University
The Fu Foundation School of Engineering and Applied Sciences
New York, New York USA

Master of Science in Computer Science December 2011

- Areas of Study: Computer Vision, Graphics, Machine Learning.

The University of Michigan
College of Engineering
Ann Arbor, Michigan USA

Bachelor of Science and Engineering in Computer Engineering April 2005

- Areas of Study: Computer Graphics, Operating Systems, Networking.

Bachelor of Science and Engineering in Electrical Engineering April 2005

- Areas of Study: MEMS Design, VLSI Design.

Academic Minor in Mathematics

Professional Experience

SightMachine
Ann Arbor, Michigan
Vice President of Research and Development **May 2011 to May 2013**

SightMachine is a start-up I helped co-found. SightMachine uses open source technology to create computer vision quality control systems for manufacturing and other industries.

- Developed a significant portion of the SimpleCV python library. SimpleCV is an open source python framework for quickly developing computer vision and image processing applications.
- Designed custom computer vision applications for industrial and manufacturing customers covering such topics as meteorology, image recognition, temporal signal processing, and color space analysis. This process included everything from initial system design and specification all the way through final testing, validation, and deployment.
- Built and managed the SimpleCV open source community. This included validating user pull requests and bug reports on github, answering question on our help forum, managing our Google Summer of Code students, co-authoring our O'Reilly publication on SimpleCV, and producing SimpleCV talks and tutorials.

- Assisted in the development and maintenance of SimpleCV.js a CoffeeScript companion library that closes follows the functionality of SimpleCV but runs in the web browser.

Cybernet Systems Corporation
Ann Arbor, Michigan USA
Research Engineer **February 2005 to December 2010**

- Worked as a lead engineer, project manager, and primary investigator on various projects and engaged in recruiting, customer relations, business development activities.

- Wrote the proposal for, won, managed, and contributed significant engineering work to four Phase I Small Business Innovative Research (SBIR) grants and two Phase II SBIR grants totaling nearly two million dollars in research funds. These projects are summarized below.

- **Live Augmented Reality Play (LARP) for Training** **Phase I & II**
  U.S. Army Research Development and Engineering Command (RDECom)
  Developed a live fire training system to supplant existing military shoot houses by replacing traditional targets with synthetic augmented reality characters. This system uses a pose determination system comprised of multiple inertial measurement systems and video-based augmented reality techniques. The vision system uses traditional "barcode" fiducials as truth points to help estimate the positions of natural image features. Natural features are mapped between the barcode truth points to provide complete training area map coverage. The inertial measurement system is used to support the visual system when low lighting or fast motion prevent the acquisition of robust camera data.

- **Vigilance: Active CCTV System** **Phase I & II**
  U.S. Research Development and Engineering Command (RDECom)
  Vigilance is a real-time, network-based, database driven system for monitoring secure facilities and roadsides for suspicious and hostile activity. For fixed cameras Vigilance uses a hybrid background modeling system that incorporates multi-layer background codebooks models and frame differencing. Feature tracking is assisted by per feature extended Kalman filtering. Once tracking is accomplished features are characterized as either humans, vehicles, or objects using boosted Haar-like classifiers and descriptive statistics like aspect ratio, size, and motion. Once features are classified the system then looks for anomalous events like loitering, the dropping off and picking up of objects, and motion that deviates from a statistical model. Data about the image features and actions within each scene is recorded in an XML schema, which is then uploaded with the image to a PostgresSQL database. This project was discussed in the October 23rd, 2008 edition of The Economist Magazine.

- **Augmented Reality for Combat Life Saver Training** **Phase I**
  Office of the Secretary of Defense - Telemedicine and Advanced Technology Research Center (TATRC)
  Working with Dr. Prof. Pamela Andreatta at the University of Michigan Clinical Simulation Center, I researched and designed a low-cost medical mannequin system for the training of the three main causes of battlefield death (tension pneumothorax, hemorrhage, and obstructed air way / cricothyrotomy). The proposed system would use augmented reality technology to perform tracking of the medical mannequin while displaying training information and medical imagery to the trainee. In addition to the core augmented reality system, we also proposed a tool and hand tracking

methodology that could recognize and evaluate common life saving tasks using multi-view shape context to analyze the user's hand configuration and common tools. The hand configuration, pose, motion, and tool selected, in conjunction with the simulation context, were to be used within an unsupervised, boosted, learning system to perform objective assessment of the combat life saver's capabilities.

- **Augmented Reality Maintenance Assistant** **Phase I**
  U.S. Marine Corps Systems Command (MARCORSYSCOM)
  Using Cybernet's proprietary touch screen tablet PC platform SWMA I created an augmented reality maintenance device that projects existing interactive electronic technical manuals onto maintenance area of the Light Armored Vehicle 25 (LAV25). The system performs tracking within the LAV25 using optical fiducials, and provides annotation, repair, and condition based maintenance data overlaid on the touchscreen tablet's screen. Using the system a maintainer could point the tablets rear mounted camera at a vehicle are, view registered annotation data on a live video feed, and then access relevant technical manual data. The user could then perform repairs using the tablets integrated repair and diagnostic tools.

- I have also worked on a variety of other projects including a computer vision controlled actuated helmet for head mounted displays, SocialSim, a pilot project to test the effect of serious gaming on education outcomes for the University of Georgia, a Lua scripted GUI for our internal render engine, and a DIS to HLA gateway to serve as a web portal to JSAF simulations.

Academic Experience

Computer Graphics and User Interface Laboratory
Columbia University, New York, New York

Research Assistant **January 2011 to December 2011**

- Under the direction of Prof. Steve Feiner assisted in the design and implementation of a collaborative augmented reality system for system maintenance and repair using the Goblin XNA architecture for the Raytheon corporation. The system allows subject matter experts to view the workspace of novice users and direct successful task completion using augmented reality visual queues.

The University of Michigan, Ann Arbor, Michigan USA

Undergraduate Research Assistant **August 2002 to April 2005**
Neural Engineering Laboratory

- Conceived and designed a software modeling system for the simulation of neurochemical diffusion in the brain. The system includes a scriptable differential equations solver, a random walk diffusion model, a Matlab data fitting interface, and an OpenGL model visualization utility. The end goal of this simulation system was the real-time spatial isolation of dopamine producing areas within live animals.

Undergraduate Research Assistant **September 2000 to August 2002**
RHex Robotics Group

- Contributed in the development of an automated tuning platform for the RHex hexapod robot. This software package tripled the energy efficiency of the robot, and greatly reduced the time required in tuning the robot's gait parameters. This research culminated in an acknowledgment in the 2004 IEEE International Conference on Robotics and Automation paper Automated Gate Adaptation for

Legged Robots

- Created a client/server application for remote data logging and processing of robotic gate parameters within Matlab. This application used UDP and Matlab C-Mex subroutines. I also oversaw many of the groups interactions with the public as well as the student body.

- Under the instruction of Professor Daniel Koditscheck and Professor Thomas Moore I completed research in the locomotion control of G. portentosa, including animal preparation and performance characterization
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Virginia Commonwealth University, Richmond, Virginia USA

Undergraduate Research Assistant **May 2001 to August 2001**
NSF Research Experience for Undergraduates Program

- Overhauled a legacy DNA synthesis machine to proper working order by replacing the internal microfluidics system.

- Participated in research into self-assembling monolayers for use in DNA detection technologies. My tasks included monolayer depositions and characterization using quartz crystal microgravimetry.

Recognition & Presentations

- 2013 PyCon talk and tutorial presentation.
- 2012 NYC Resistor SimpleCV Class.
- 2011 New York Tech Meetup Presenter.
- 2011 City College of New York Kaylie Prize Recipient.
- 2003 President RHex Robot Student Group
- 2001 NSF-REU Student
- 1997 Youth For Understanding Polish-American Exchange Student

Publications

- DeMaagd, Oliver, Oostendorp, and Katherine Scott *Practical Computer Vision with SimpleCV* , Cambridge: O'Reilly, 2012. Print.
- Scott, Katherine A., Dean, Frank. Haanpaa, Doug. Todd, James. "Sensor Fusion for Live Training Augmented Reality." *2008 Simulation Interoperability Standards Organization's Simulation Interoperability Workshop.* Orlando, FL. September 15-19, 2008.
- Cohen, Charles J., Frank Morelli, Katherine Scott,"A Surveillance system for the Recognition of Intent within Individuals and Crowds." *2008 IEEE Conference on Technologies for Homeland Security.* Waltham, MA. May 12-13, 2008.
- Hay, Ron, Katherine Scott, Charles J. Cohen, "Simulations as an Educational Environment for Balancing Disparate Needs." *2006 Huntsville Simulation Conference.* Huntsville AL. October 17, 2006 to October 19, 2006.

- Hay, Ron, Katherine Scott, Charles J. Cohen. "Simulations as an Educational Environment for Balancing Disparate Needs." *2006 Simulation Interoperability Standards Organization's Simulation Interoperability Workshop*, Orlando, FL, September 10-15, 2006.
- Johnson M.D., Franklin R.K., Scott K.A., Brown R.B., Kipke D.R. "Neural probes for concurrent detection of neurochemical and electrophysiological signals in vivo." *Proceedings of the 27th Annual International Conference of the IEEE Engineering in Medicine and Biology Society.*
- Franklin, R.K. Johnson, M.D. Scottt, K.A. Jun Ho Shim Hakhyun Nam Kipket, D.R. Brown, R.B, "Iridium oxide reference electrodes for neurochemical sensing with MEMS microelectrode arrays." *The 4th IEEE Conference on Sensors.* Oct. 31 Nov. 3, 2005, Irvine, CA, US.
- Johnson M.D., Franklin R.K., Scott K.A., Brown R.B., Kipke D.R. "Neurochemical sensing with MEMS-based microelectrode arrays." Poster presented at WIMS fall 2004 conference, Ann Arbor, USA, October 22, 2004.
- Johnson M.D., Scott K.A., Kipke D.R. "Hybrid neural implant systems: the chemical interface." Poster presented at WIMS spring 2004 conference, Ann Arbor, USA, May 2004.
- Joel D. Weingarten, Gabriel A. D. Lopes, Martin Buehler, Richard E. Groff and Daniel E. Koditschek, "Automated Gait Adaptation for Legged Robots", *IEEE International Conference on Robotics and Automation.* New Orleans, USA, April 2004.

Patents Submitted

- Foulk, Eugene. Hay, Ronald. Scott, Katherine. Squiers, Merrill D. Tesar, Joseph. Cohen, Charles J. Jacobus Charles J."Method for Controlling a GUI for Touchscreen Enabled Computers" Patent 12/131,375 June-2-2008.
- Scott, Katherine A. Haanpaa, Douglas P. Jacobus Charles J. "Augmented Reality for Equipment Maintainers." Patent 12/478.526. June-4-2009.
- Scott, Katherine A. Haanpaa, Douglas P. Jacobus Charles J. "Automatic Fiducial Location and Orientation Estimation Using a Single Truth Point." Patent 12/546,266. August-24-2009.

Technical Skills

Languages:
Python, C++, C, C#, Java, Lua, Common Lisp, Coffee Script, UNIX shell scripting, MySQL.

Libraries:
OpenCV, OpenGL, Numpy, Scipy, SimpleCV, SciKits, OGRE, Boost, TinyXML, COM, MFC, GoblinXNA, Android SDK, and many more.

Tools and Environments:
Unix, Linux, Windows, OS X, CVS, SVN, Trac, Git, Make, Visual Studio, NetBeans, Eclipse, EMacs, XEMacs, Matlab, and iPython Notebooks.

Applications:
TEX, LATEX, BIBTEX, Microsoft Office, and other common productivity packages for Windows, OS X, and Linux platforms

Interests & Hobbies

- I am an avid gardener with a passing interest aquariums and aquaculture, and plant collecting. I completed five years with Ann Arbor's Project Grow Community Gardens, and two years volunteering with the Serenity Community Garden in Harlem, New York.
- For the 2012-2013 competition season I was a programming and electrical engineering mentor for FIRST Robotics Competition Team 830.
- I spent five years living in and organizing Arbor Vitae, a fifty year old historic cooperative loft in Ann Arbor, Michigan. Arbor Vitae currently houses one of the largest libraries of world peace and peace activism materials, and frequently hosts community arts events.