

# Girish Narayanswamy

Health Sensing || ML & AI || Signal Processing || Embedded Systems

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Girish is a second year PhD Student in the **Ubiquitous Computing Lab** at the University of Washington, where he is advised by Professor **Shwetak Patel**. Girish's interests lie at the intersection of **Learning (ML/AI)**, **Signal Processing**, and **Embedded Systems** with an emphasis in **Multimodal Sensing**, **On-Device Deep Learning** and **Mobile Health**.

## Education

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<b>University of Washington Seattle</b> <i>PhD Electrical &amp; Computer Engineering</i> <i>Advised by Shwetak Patel    UbiComp Lab</i>	Sep. 2020 - Present GPA: 4.00
<b>University of Colorado Boulder</b> <i>BS Electrical &amp; Computer Engineering (Magna Cum Laude &amp; Eng. Honors)</i> <i>Minor Computer Science</i>	Aug. 2014 - May 2019 GPA: 3.86

## Research

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<b>Non-Contact Physiological Sensing with mmWave Radar + Camera</b> <i>Project Lead</i> <ul style="list-style-type: none"><li>• mmWave radar + camera sensor fusion to reduce bias in heart and respiration signal monitoring DNNs</li><li>• Multimodal sensing to improve performance across all skin colors and lighting conditions</li><li>• Hardware / software system for synchronous mmWave radar / camera / ground truth data collection</li><li>• Next steps: Model architecture, data collection, model training / analysis</li></ul>	Aug. 2021 - Present
<b>MaskFlow</b> <i>Project Lead</i> <ul style="list-style-type: none"><li>• Project in collaboration with UW MISL Lab and Microsoft Research to gauge face-mask efficacy and breathability using commodity audio sensing</li><li>• Invited talk to Microsoft CSO, Eric Horvitz, as part of Pandemic Preparedness research presentation series</li><li>• White paper in progress</li></ul>	May 2021 - Present
<b>UroSound</b> <i>ML/AI Support</i> <ul style="list-style-type: none"><li>• Use of commodity smart watch audio to track voiding patterns and to test for voiding dysfunction (especially in the elderly patients)</li><li>• Use of CNN and Random Forrest to classify voiding flow type</li><li>• Paper accepted for 2022 IEEE EMBC</li></ul>	Mar. 2020 - Present
<b>Lung Mapping Using Synthetic Aperture UWB Radar</b> <i>Support</i> <ul style="list-style-type: none"><li>• Use of ultra-wideband radar along with commodity IMU to image lungs</li></ul>	Mar. 2022 - Present

## Work Experience

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<b>UW Ubiquitous Computing Lab</b> <i>Research Assistant</i> <ul style="list-style-type: none"><li>• Research focused on mobile health sensing, efficient deep learning, and multimodal sensing. Current research projects can be found above</li></ul>	Sep. 2020 - Present
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<b>Uplinq</b> <i>Machine Learning Consultant</i>	Sep. 2020 - Present
<ul style="list-style-type: none"> <li>• Early stage start up looking to make bookkeeping and operations data more accessible for small businesses</li> <li>• Developing a pipeline to automate small-business-bookkeeping through both deterministic and ML solutions</li> </ul>	
<b>UW ECE: Signal Processing I</b> <i>Teaching Assistant</i>	Sep. 2021 - Dec. 2021
<ul style="list-style-type: none"> <li>• Taught lab sections, held office hours, graded labs / tests</li> <li>• Python, Audio Processing, Computer Vision</li> </ul>	
<b>OctoML</b> <i>ML System Intern</i>	Jul. 2021 - Oct. 2021
<ul style="list-style-type: none"> <li>• Developed system to offload deep learning inference workload from microcontroller to custom FPGA accelerator</li> <li>• Pipeline to interface with OctoML's uTVM ML accelerator runtime</li> <li>• Deep Learning, FPGA, Embedded Systems, Hardware specific model optimization</li> </ul>	
<b>UW ECE: Computer Vision - Classical &amp; Deep Methods</b> <i>Teaching Assistant</i>	Sep. 2020 - Dec. 2020
<ul style="list-style-type: none"> <li>• Developed lab material, held office hours, graded homework / labs / projects</li> <li>• Python, OpenCV, PyTorch, Image Processing, Deep Learning</li> </ul>	
<b>CU Hearing Research Lab</b> <i>Research Assistant</i>	Aug. 2019 - May 2020
<ul style="list-style-type: none"> <li>• Developed tools and GUIs for use in audiology clinical studies</li> <li>• Deep learning to predict audio quality and perception (HASQI/HASPI)</li> </ul>	
<b>Qualcomm Technologies</b> <i>R&amp;D Software Intern</i>	Jun. 2018 - Sep. 2018
<ul style="list-style-type: none"> <li>• Member of the 11ax Wifi PHY modeling team</li> <li>• Built framework to package, store, and visualize simulation results</li> </ul>	
<b>CU Correll Lab</b> <i>Undergraduate Research Assistant</i>	Oct. 2016 - Jun. 2017
<ul style="list-style-type: none"> <li>• UROP grant to color characterize novel force-proximity sensor used for a robotic claw</li> <li>• Assisted in integration of the sensor onto a prosthetic hook</li> </ul>	
<b>CU ECE: Applications of Embedded Systems</b> <i>Teaching Assistant</i>	Aug. 2016 - Dec. 2016
<ul style="list-style-type: none"> <li>• Developed lab material, held office hours, graded homework, labs, projects, and tests</li> <li>• Embedded C, TI MSP432 ARM Cortex M4 mcu, software / hardware Debug</li> </ul>	
<b>Medtronic</b> <i>R&amp;D Software Intern</i>	May 2016 - Aug. 2016
<ul style="list-style-type: none"> <li>• Member of the surgical device R&amp;D software team</li> <li>• Created audio feedback drivers for Ultrasonic Tissue Dissector</li> </ul>	

## Projects

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<b>Disease Spread in Small Population Networks</b>	Apr. 2019 - May 2019
<ul style="list-style-type: none"> <li>• Graph analysis to test similarity of sampled-co-presence and face-to-face networks</li> <li>• Applied to disease spread and vaccination in small population graphs (100-500 nodes)</li> </ul>	
<b>Melanoma Detection Application</b>	Apr. 2019 - May 2019
<ul style="list-style-type: none"> <li>• Mobile application to detect melanoma given a skin-growth image</li> <li>• 80% accuracy using decision tree model. Improved to 90% with use of shallow NN</li> </ul>	
<b>Configurable Human Interface Device (Senior Design Project)</b>	Aug. 2017 - May 2018
<ul style="list-style-type: none"> <li>• Configurable controller intended to improve disability technology access</li> <li>• Touchscreen, buttons, joystick, Bluetooth, ARM m4 MCU, IMU</li> <li>• PCB design, firmware and application development, rapid prototyping, component selection, requirement setting</li> </ul>	

## Audio Genre Classifier

Apr. 2017 - May 2017

- Statistically analyzed parameters derived from tracks using signal processing
- Classification was improved by using a pre-built Matlab support vector machine

## Selected Skills and Coursework

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**Programming Skills** Python, C, C++, MATLAB, Java (working knowledge), ML / AI (PyTorch, Tensor Flow, scikit-learn), Computer Vision (OpenCV), ARM microcontrollers, Firmware development, UART, I2C, SPI, Unix, Linux, GitHub, Debugging

**Electrical Eng. Skills** PCB Design, SMT / Through-Hole Soldering, Oscilloscope, Function Generator, Logic Analyzer, Multimeter, Hardware Debugging

**Programming Courses** Deep Learning (grad), Machine Learning (grad), Artificial Intelligence (grad), High Dimensional Dataset Analysis (grad), Principles of Embedded Software (grad), Data Visualization (grad), Data Structures, Algorithms, Operating Systems, C Programming, Computer Organization, Applications of Embedded Systems

**Electrical Eng. Courses** Digital Signal Processing (grad), PCB Design (grad), Linear Systems, Circuits as Systems, Digital Logic, Electromagnetic Fields and Waves

**Mathematics Courses** Calc. I/II/III, Differential Eqs., Linear Algebra, Discrete Math, Probability, Matrix Methods

**Other** Entrepreneurship (grad)

## Publications and Invited Talks

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### Conference Papers

- **Girish Narayanswamy**, Laura Arjona, Luis E. Diez, Alfonso Bahillo, Shwetak Patel, "Automatic Classification of Audio Uroflowmetry with a Smartwatch" (Accepted to IEEE EMBC 2022)

### Talks

- **Assessing Face Mask Filtration Capability, Breathability, and Fit with Commodity Smartphones** (MSR Pandemic Preparedness Series - Sep. 2021)
- **Non-contact Physiological Sensing w/ Radar and Camera** (UW ECE Research Showcase - Mar. 2022)

## Honors, Leadership, and Extracurriculars

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### ACM COMPASS 2022 Posters TCP

**Global Innovation Exchange (GIX) Research Mentor** Access Computing Summer Program (ACSP) ugrad research program coordinated by University of Washington, Tsinghua University, and Microsoft (Su' 22)

**UbiComp Seminar Co-Organizer** Co-organized Ubiquitous Computer research seminar (Wi' 2021)

**UbiComp Lab Ugrad Research Coordinator** Organizing undergraduate research and recruitment

**UbiComp Lab Workshop / Tutorials / Deep Dives Organizer:** Organizing research presentations and tutorials

**UbiComp Lab Paper Repository Co-Manager:** Co-managing lab's Zotero paper repository

**UW ECE Graduate Application Support Programs (GASP) Mentor:** Held office hours and provided application feedback to help students (primarily from under-served communities) applying to graduate programs

**Engineering Honors Program:** Selective residence program based of applicant's academics/extracurriculars

**Outstanding Colleague Award:** Presented by department of Electrical and Computer Engineering at CU Boulder

**UROP Individual Grant:** Grant to research and color characterize force-proximity sensor for smart prosthetics

**CU Dean's List:** All semesters (Fall 2014 - Spring 2019)

**Ugrad Scholarships:** Intel Merit, BOLD, Engineering Differential, Sewall Esteemed

**Boulder Lotus:** One of the nation's top 15 club-level ultimate frisbee teams

**University of Colorado Mamabird:** One of the nation's top 5 collegiate ultimate frisbee teams

**Fairview HS Ultimate Frisbee Coach:** Head coached 2019 - 2020 Fairview HS ultimate frisbee team

**Shotokan Karate:** Shodan (first degree black belt), Senpai (instructor) at International Martial Arts Association

**Interests:** Photography (ig: gvn\_photos), Hiking, Camping, Skiing, Board / Card Games, Reading