**Keshav Bimbraw**

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******EDUCATION**

**Worcester Polytechnic Institute**, Worcester, MA

Ph. D. Candidate in Robotics Engineering (Medical FUSION Lab) Aug ‘20 – May ’25

Concentration – Medical Robotics, Deep Learning, Ultrasound Image Processing, & Human-Machine Interfacing *4.00/4.00 GPA*

**Georgia Institute of Technology**, Atlanta, GA

M. S. with Robotics Focus (Music Technology, Computer Software & Media Applications) Aug ‘17 – May ‘19

Concentration – Human Augmentation, Medical Robotics & Robotic Musicianship *3.56/4.00 GPA*

**Thapar University,** Patiala, India

B. E. in Mechatronics Engineering (Research Intern - IIT Delhi, Jan – Jul ‘16) July ‘13 – June ‘17

Concentration – Robotics & Mechatronics *4.00/4.00 GPA (8.34 CGPA)*

**EXPERIENCE**

**OnPoint Surgical**  Concord, MA

**Software Engineer, Machine Learning**  Oct ‘24 – now

* Leading AI efforts at OnPoint Surgical, developing solutions for classification, segmentation, and registration in MRI, CT, and XR.

**Mitsubishi Electric Research Laboratories**  Cambridge, MA

**Research Intern (Connected Interfaces Group, Mentor: Toshiaki Koike-Akino)** May ’23 – Aug ’23; June ’24 – Aug ’24

* Worked on exciting research directions focusing on Generative AI and Vision Language Models (VLMs) like GPT-4o. [Paper](https://arxiv.org/abs/2407.10870).
* Designed pipelines for multi-modal biosignal data acquisition and human-machine interaction in AR/VR/XR applications.
* Incorporated adversarial regularization to bolster hand gesture classification performance in the context of domain adaptation.
* Leveraged randomized channel ablation to optimize the performance of multi-modal biosignal modalities ([IEEE EMBC 2024](https://arxiv.org/abs/2407.10874)).

**Worcester Polytechnic Institute (WPI)** Worcester, MA

**Research Assistant (Medical FUSION Lab)** March ‘20 – now

* Developed a novel ultrasound-based method to simultaneously estimate manipulation skill type and grasp forces from forearm muscle activity, enabling real-time, high-resolution dexterity assessment for HMI applications.
* Funded by Amazon GBTI grant for the 2023-2024 academic year to use ultrasound to estimate finger forces to improve a haptic feedback system. Demonstrated ultrasound based continuous force estimation with an error of 5% (IEEE IUS ’23). [Paper](https://ieeexplore.ieee.org/abstract/document/10306652). [Video](https://youtu.be/eVyNQ7SFq8k).
* Developed an innovative mirror-based ultrasound system for gesture classification, utilizing Convolutional Neural Networks (CNNs) and Vision Transformers (ViT), and achieving a gesture classification accuracy of 93% (SPIE Medical Imaging ’24). [Paper](https://www.spiedigitallibrary.org/conference-proceedings-of-spie/12932/129320Z/Mirror-based-ultrasound-system-for-hand-gesture-classification-through-convolutional/10.1117/12.3005247.full).
* Developed a data-driven hand gesture recognition pipeline for VR interfacing (Meta Quest Pro) using ultrasound data and CNNs, achieving online accuracy of 92% for 4 gestures, and a low pipeline latency of 59.48 ms. [Paper](https://ieeexplore.ieee.org/document/10331075). [Video](https://youtu.be/8Cx___jnLJM).
* Developed a deep learning based pipeline to predict finger angles & hand configurations from forearm ultrasound images. Achieved an error of 7.35⁰ for finger joint angle prediction (IEEE ICRA ’22). [Paper](https://ieeexplore.ieee.org/abstract/document/9812287?casa_token=sQC_RsEr3x8AAAAA:WIQu8lAm3-a3pNmmauXmSBz1zKSLBlVYphsFiUzJbRI4hKSKds3lO0ta96yjy3JODULj1w). [Video](https://www.youtube.com/watch?v=YdhpU829e-M). Extended version published in [IEEE T-MRB](https://ieeexplore.ieee.org/abstract/document/10020174).
* Conceptualized a novel augmented reality based lung ultrasound scanning guidance system (MICCAI ASMUS ‘20). [Paper](https://link.springer.com/chapter/10.1007/978-3-030-60334-2_11). [Video](https://vimeo.com/463333665).
* Established the real-time ultrasound data acquisition software framework for a tele-operative low-cost lung ultrasound robot. [Paper](https://pubmed.ncbi.nlm.nih.gov/34532570/).

**Nokia Bell Labs** New Providence, NJ

**Augmented Human Sensing Co-Op (Data and Devices Group, AI Research Lab)** June ‘22 – Dec ‘22

* Designed low-latency biosignal based pipelines (sEMG, IMU) to estimate bodily motion for Human-Machine Interaction. [Video](https://youtu.be/GSJTYDu5IxQ).
* Submitted and presented a paper ([IEEE SII 2023](https://ieeexplore.ieee.org/abstract/document/10039467)) and multiple invention reports. Offered a Co-Op extension, which was accepted.
* Developed demonstrations for biosignal-based remote multi-sensor real-time shared-autonomy industrial robotic applications.
* Investigated multi-channel sEMG based hand movement classification for robotic control using deep learning (MLP, CNN).
* Utilized transfer learning for improving performance of sEMG based hand configuration classification from 91% to 96%.

**Agile Resources Inc.** Alpharetta/Peachtree City, GA

**Audio DSP Engineer (Panasonic Automotive Systems of America)**  Oct ‘19 – March ‘20

* Developed Qualcomm’s Hexagon SDK for audio applications in Eclipse on Android framework development.

**Bose Corporation** Stow, MA

**Active Noise Control Engineering Intern (Automotive Systems Division)**  May ‘19 – Oct ‘19

* Designed sound synthesis framework for electric vehicles and implemented processor-optimized signal processing algorithms.
* Devised a physical car sound simulation system using Logitech pedals to evaluate models and reduce testing time.

**Georgia Institute of Technology (Georgia Tech)** Atlanta, GA

**Research Assistant (Robotic Musicianship Lab)**  Aug ‘17 – May ‘19

* Led the ML based ultrasound gesture classification [project](https://gtcmt.gatech.edu/skywalker) from Aug ‘18 – May ‘19. Robot and code featured in [The Age of A.I](https://youtu.be/UwsrzCVZAb8?t=1079).
* Investigated a combination of Ultrasound & EMG data using supervised learning algorithms to enhance assistive robot control.
* Created an ultrasound in the loop tendon-based wearable exoskeleton for upper extremity rehabilitation of stroke survivors. [Link](https://drive.google.com/file/d/10ZK2K1fI90I0AVr5jjTlthfDECNXcPIK/view?usp=sharing).
* Taught Computer-Aided Design (CAD), Fusion 360, 3D printing, and Mechatronics for Project Studio Course. [Link](https://vimeo.com/444132536), [Link](https://drive.google.com/file/d/1PYHPMrOLP6-12o97rCuxAX5ZVvhJofBY/view?usp=sharing).

**IIT Delhi** New Delhi, India

**Research Intern (Autonomous Robotics Lab)** Jan ‘16 – Aug ‘16

* Conceptualized and programmed the system framework for two KUKA KR-5 robotic arms to collaboratively play a guitar. [Link](https://vimeo.com/174093155).
* Improved performance of a 6 DOF motion platform at Simulator Development Division, Secunderabad, India. [Link](https://ieeexplore.ieee.org/abstract/document/7931899).
* Developed a teach pendant and a control module to control virtual robots in RoboAnalyzer software. [Link](https://ieeexplore.ieee.org/abstract/document/7931881).

**SKILLS**

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**Software Skills** Python, TensorFlow, PyTorch, ROS, Linux, NumPy, MATLAB, OpenCV, C++

**3D Design/3D printing** SolidWorks, Autodesk Inventor, Autodesk Fusion 360, Unity, TinkerCAD, Cura

**Electrical/Electronic skills** Arduino, Raspberry Pi, Motors, Actuators, Hardware & software interfacing

**Programming Frameworks** Shell Scripting, Git, Visual Studio Code, PyCharm, Version Control, AWS Cloud

**RECENT ACADEMIC PROJECTS**

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**Analyzing the performance of a cart pole system for different parameters for RL (WPI, Artificial Intelligence)**  Spring ‘23

* Analyzed an RL framework in OpenAI Gym to evaluate cart-pole stability under varying parameters using DQN & Q-learning.

**Comparing low & high-dimensional forearm ultrasound-based hand state classification (WPI, Machine Learning)**  Spring ‘22

* Investigated the feasibility of using image compression techniques for extracting the latent structure of ultrasound images. [Link](https://drive.google.com/file/d/17gE6GYWe8PWJ5g-VtjKLZz2YO8X6IP-3/view?usp=sharing).
* Designed a real-time ML pipeline for training and testing models for hand motion classification based on forearm ultrasound.

**LEADERSHIP**

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* Mentored high school & undergraduate students towards ongoing projects through MLSC, MQP & REU (WPI), & VIP (GT).
* Senator and representative of the Robotics Department for the Graduate Student Government for academic year ’21 - ‘22.

**SELECTED HONORS & AWARDS (Full list:** [**CV**](https://bimbraw.github.io/files/Keshav_Bimbraw_CV.pdf)**)**

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| • Won PhD Backlin Scholarship to cover tuition and health insurance through WPI. | Sept. ‘24 |
| • Won IEEE EMBC NextGen Scholar Award. | May ‘24 |
| • Funded through Amazon Robotics GBTI Award for the 2023-2024 academic year (Tuition support & yearly award) | August ‘23 |
| • Selected for the 2021B cohort of Google Research’s CSRMP. The first person at WPI to have ever been selected. | Sept. ‘21 |
| • Awarded PhD positions at WPI & Georgia Tech. Accepted the WPI offer. (Tuition support & $31824 yearly award). | March ‘20 |
| • Scholarship to pursue master’s at Georgia Tech (Tuition support & $14100 yearly award). | August ‘17 |
| • Awarded merit scholarships and grants totaling INR 336,000 at Thapar University. | June ‘17 |

**SELECTED FIRST-AUTHOR PUBLICATIONS (Full list:** [**CV**](https://bimbraw.github.io/files/Keshav_Bimbraw_CV.pdf)**)**

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1. **Bimbraw, K.**, Steines, D. (2025, May). Tranfer Learning and Quantization for Efficient AP vs. LA X-Ray View Classification on an Edge Device. In *MIDL*. [Paper](https://openreview.net/pdf?id=vZEgKxcUQJ).
2. **Bimbraw, K.**, Wang, Y., Liu, J., & Koike-Akino, T. (2024, July). GPT Sonograpy: Hand Gesture Decoding from Forearm Ultrasound Images via VLM. In arXiv:2407.10870. [Paper](https://arxiv.org/abs/2407.10870).
3. **Bimbraw, K.**, Zhang, H. K., & Islam, B. (2024, September). Forearm Ultrasound based Gesture Recognition on Edge. In *IEEE-EMBS BSN 2024*. [Paper](https://arxiv.org/abs/2409.09915).
4. **Bimbraw, K.**, Liu, J., Wang, Y., & Koike-Akino, T. (2024, July). Random Channel Ablation for Robust Hand Gesture Classification with Multimodal Biosignals. In *2024 IEEE Engineering in Medicine and Biology Conference (EMBC)* (pp. 1-6). IEEE. [Paper](https://arxiv.org/abs/2407.10874).
5. **Bimbraw, K.**, & Zhang, H. K. (2024, April). Mirror-based Ultrasound System for Exploring Hand Gesture Classification through Convolutional Neural Network and Vision Transformer. In *Medical Imaging 2024* (Vol. 12932, pp. 218-222). SPIE. [Paper and Video](https://www.spiedigitallibrary.org/conference-proceedings-of-spie/12932/129320Z/Mirror-based-ultrasound-system-for-hand-gesture-classification-through-convolutional/10.1117/12.3005247.full).
6. **Bimbraw, K.**, Rothenberg, J., & Zhang, H. K. (2023, October). Leveraging Ultrasound Sensing for Virtual Object Manipulation in Immersive Environments. In *IEEE-EMBS International Conference on Body Sensor Networks 2023*. [Paper](https://ieeexplore.ieee.org/document/10331075). [Video](https://youtu.be/8Cx___jnLJM).
7. **Bimbraw, K.**, & Zhang, H. K. (2023, September). Estimating Force Exerted by the Fingers Based on Forearm Ultrasound. In *IEEE IUS*. [Paper](https://ieeexplore.ieee.org/abstract/document/10306652). [Video](https://youtu.be/eVyNQ7SFq8k).
8. **Bimbraw, K.**, Bimbraw, K., & Zheng, M. (2023, January). Towards The Development of a Low-Latency, Biosignal-Controlled Human-Machine Interaction System. In 2023 IEEE/SICE International Symposium on System Integration (SII) (pp. 1-7). IEEE. [Paper](https://bimbraw.github.io/files/SII_2023_Paper_Accepted_Version.pdf). [Video](https://youtu.be/GSJTYDu5IxQ).
9. **Bimbraw, K.**, Nycz, C. J., Schueler, M. J., Zhang, Z., & Zhang, H. K. (2022, May). Prediction of Metacarpophalangeal joint angles & Classification of Hand configurations based on Ultrasound Imaging of the Forearm. In: *IEEE ICRA* (pp. 91-97). IEEE. [Pape](https://ieeexplore.ieee.org/abstract/document/9812287?casa_token=sQC_RsEr3x8AAAAA:WIQu8lAm3-a3pNmmauXmSBz1zKSLBlVYphsFiUzJbRI4hKSKds3lO0ta96yjy3JODULj1w)r. [Video](https://youtu.be/YdhpU829e-M). [*Journal*](https://ieeexplore.ieee.org/abstract/document/10020174)*: IEEE Transactions on Medical Robotics & Bionics.*
10. **Bimbraw, K.**, Ma, X., Zhang, Z., Zhang, H. (2020). Augmented Reality-Based Lung Ultrasound Scanning Guidance. In: *ASMUS 2020.* [Paper Link](https://link.springer.com/chapter/10.1007/978-3-030-60334-2_11). [Video](https://vimeo.com/463333665).