Barathi Subramanian

Contact Details

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Research Interests

- Image Classification
- Object Detection and Segmentation
- Anomaly Detection
- Gesture Recognition
- Vision Language Modelling

Research Domain

- Computer vision
- Healthcare

Top Research Publications

- MICCAI 2026
- CVPR 2026
- NeurIPS 2025

Professional Memberships

- IEEE
- ACM

Technical Skills

Computer Vision

◇ Classification: Vision Transformers (ViT), Transfer Learning, Fine-tuning
◇ Object Detection: YOLO and DETR (Detection Transformer)
◇ Image Segmentation: U-Net, SegFormer, and Segment Anything Model (SAM)
◇ QuPath and Roboflow for Object Annotation

Generative AI

◇ Architectures: Transformers (LLM), Attention Mechanisms, Multi-Modal (VLM)
◇ Optimization: Knowledge Distillation

MLOps & Engineering

◇ Lifecycle: MLflow, Experiment Tracking, Model Versioning
◇ Inference & Deployment: Streamlit (Prototyping), Docker Containerization
◇ Infrastructure: Multi-GPU Handling, Distributed Training

DevOps

◇ Platforms: AWS, Google Cloud Platform (GCP), Docker
◇ CI/CD: GitHub Actions, Version Control (Git)

Hands-on Experience

- Built end-to-end digital pathology pipelines for WSI/tile classification & segmentation with rigorous preprocessing (artifact filtering, tile extraction, quality control, color standardization).
- Trained and deployed multimodal pathology foundation models (image + text) for analysis and reporting.
- Created tumor annotations in QuPath and established high-quality ground truth and QA workflows; curated a large tile-level tissue dataset for benchmarking/reproducibility.
- Executed Groovy scripts in QuPath to integrate custom user-defined modules for advanced visualization workflows and automated detection model execution.
- Extended PyTorch by overriding core modules to customize training behavior.
- Delivered production systems: spectral clustering for fabric-defect detection, YOLOv5 for small objects, and transfer-learning for anomaly localization.
- Built gesture-recognition pipelines with MediaPipe (face/hand landmarks) and real-time inference.
- Developed a CNN–BiLSTM OCR system for generating historical Korean handwriting to modern text.
- Segmented malignant patterns in dermatology images; adapted similar CV methods to autonomous-driving perception tasks.
- Improved robustness via targeted augmentation/sampling/regularization and diagnostic visualization (t-SNE, PCA).
- Led projects as coordinator, developer, and team lead, driving collaboration, planning, and on-time execution.

Employment History

Post-doc Scholar **07/2024 – Present**
◇ Stanford University, California, USA.

Research Assistant **03/2021 – 02/2024**
◇ Kyungpook National University, Daegu, South Korea.

Education

Ph.D. in Computer Vision **2020 – 2024**

◇ Kyungpook National University, Daegu, South Korea.

M.Sc., Applied Mathematics with Computer Applications **2013 – 2015**

◇ Bharathiar University, Coimbatore, India.

Achievements

◇ Charles B. Carrington Memorial Award for Outstanding Poster Presentation (2026), Stanford University.
◇ Best Thesis Award (2024), Kyungpook National University.
◇ Best Paper Awards (2021–2022) across multiple conferences.
◇ Volunteer (2015): collaborated with NASA scientists at a science exhibition hosted by Bharathiar University, India.

Research Projects Involved

Multi-modal analysis in digital pathology **07/2024 – Present**

◇ **Funder:** National Institutes of Health (NIH), USA.
◇ **Objective(s):** Develop end-to-end WSI and multimodal analysis workflows for histopathology.
◇ **Role:** Post-doc researcher
◇ **Responsibilities:**

- Building end-to-end pipelines for whole-slide image (WSI) and tile-level tissue classification and segmentation in digital pathology.
- Implementing robust preprocessing pipelines for pathology images (artifact filtering, tile extraction, and quality checks) to ensure clean, consistent model inputs at scale.
- Training and deployed pathology foundation models (image + text) for multimodal analysis and reporting.
- Annotating tumor regions in WSIs using QuPath, creating high-quality ground truth for model development and quality checking.
- Curating a large-scale tile-level tissue classification dataset to support benchmarking and reproducible research.

Abnormal image detection and Localization of fabric products **09/2022 – 02/2024**

◇ **Funder:** National Research Foundation (NRF), South Korea.
◇ **Objective(s):** Detect and localize fabric defects for automated quality control.
◇ **Role:** Project Lead
◇ **Responsibilities:**

- Applied spectral clustering to split images into defect/non-defect groups for binary classification.
- Detected and localized defects via transfer learning with deep CNNs.

Gesture recognition **02/2022 – 05/2023**

◇ **Funder:** School of Computer Science and Engineering, Kyungpook National University, South Korea.
◇ **Objective(s):**

- Building a real-time, gesture-driven music generation system.
- Developing gesture-based sign-language detection using hand/pose landmarks.

◇ **Role:** Project Lead
◇ **Responsibilities:**

- Curated multi-label datasets for Indian Sign Language (ISL) and gesture-based music generation.
- Extracted face and hand landmarks using MediaPipe, producing time-stamped sequences.
- Modeled temporal dynamics with GRU architectures to learn gesture patterns.
- Generated aligned outputs, ISL text and musical notes, from the detected and classified poses.

Lightweight model for Disabled Sign Detection **07/2021 – 12/2021**

◇ **Funder:** Small and medium business technology information promotion agency, South Korea.
◇ **Objective(s):**

- Enhanced small-object detection in YOLOv5, targeting the Disabled Car sign.
- Built a lightweight fused-architecture variant (LF-YOLOv5) that reduces parameters/FLOPs while maintaining accuracy.

◇ **Role:** Project Developer and Lead

◇ **Responsibilities:**

- Analyzed small-object detection challenges and the real-world importance of recognizing Disabled Car signs.
- Enhanced YOLOv5 by integrating PANet and Weighted BiFPN for stronger multi-scale feature fusion.
- Reduced computational cost by clipping feature-map outputs, yielding a more lightweight, efficient model.
- Ran experiments on 1,025 Disabled-sign images, augmented to 15,000 samples for robust training and evaluation.

Korean handwritten text recognition **12/2021 – 02/2022**

◇ **Funder:** Small and medium business technology information promotion agency, South Korea.
◇ **Objective(s):** Transcribing historical Korean handwriting into modern Korean text.
◇ **Role:** Project Lead
◇ **Responsibilities:**

- Labeled handwritten text and drew bounding boxes using a CNN-based detector.
- Transcribed the detected regions with a Bi-LSTM sequence model.

Real-Time Emotion Recognition System **03/2021 – 02/2022**

◇ **Funder:** Small and medium business technology information promotion agency, South Korea.
◇ **Objective(s):**

- Built a real-time Emotion Recognition (ER) system for personalized healthcare using machine-learning models.
- Integrated ER with a digital-twin platform to enable early diagnosis and more effective treatment of potentially life-threatening conditions.

◇ **Role:** Project Developer
◇ **Responsibilities:**

- Created a custom webcam dataset capturing diverse emotional expressions across varied real-world scenarios.
- Implemented MediaPipe for preprocessing and multi-region landmark extraction (face, hands, body).
- Built an end-to-end emotion-aware decision-support framework linking real-time ER to a digital twin.
- Trained and benchmarked multiple ML algorithms to select the most efficient, accurate ER pipeline.

Research Proposals

Contributed to research proposal development by defining project scope, budgets, timelines, and deliverables to secure industry sponsorships:

1. AI-based Accessible Parking Enforcement System (Sauna Project, **2023**), developed to protect accessible-parking rights for people with disabilities.
2. Self-Supervised & Diffusion Modeling for Video Anomaly Detection (NRF proposal submitted, **2023**).
3. Handwritten Korean Character Recognition (OCR) (Sauna Project; Small and Medium Business Technology Information Promotion Agency, **2022**).
4. Image Text Extraction (OCR) (Sauna Project, **2022**).

Research Publications

Current Submissions (5)

1. Rathinaraja Jeyaraj, Barathi Subramanian, Jeanne Shen, et al., "MUFASA: An Information Utility-Aware Preprocessing Framework for Reliable Model Reasoning in Computational Pathology," in preparation for submission to Nature Biomedical Engineering.
2. Rathinaraja Jeyaraj, Barathi Subramanian, et al., "HMS: Bounded Harmonic Mean Perturbations for Stabilizing SGD-Based Regression Optimization," in preparation for submission to AAAI 2027.
3. X.Wu, H.Tan, Barathi Subramanian, H.Chen, M.Peterson, T.Guo, A.Kiani, S.Noh, X.Qi, J.Shen, "MedVES: Visual Evidence Scaling at Test Time for VLMs in Medical VQA," under review at ACMMM 2026.
4. Barathi Subramanian, Rathinaraja Jeyaraj, et al., "APALU: A Trainable, Adaptive Activation Function for Deep Learning Networks," in preparation for submission to Neurocomputing.

Journal Articles (11)

1. C.Qiu, S.Miller, B. Subramanian, A.Ryu, H.Zhang, G.Fisher, N.Shah, J.Mongan, C.Langlotz, P.Poullos, J.Shen, "A Deep Learning-Based Automated Pipeline for Colorectal Cancer Detection in Contrast-Enhanced CT Images," Computerized Medical Imaging and Graphics, vol 128, **2026**.

2. C.Qiu, S.Miller, B. Subramanian, A.Ryu, H.Zhang, G.Fisher, N.Shah, J.Mongan, C.Langlotz, P.Poullos, J.Shen, “A Deep Learning-Based Automated Pipeline for Colorectal Cancer Detection in Contrast-Enhanced CT Images,” Computerized Medical Imaging and Graphics, vol 128, **2026**.
3. K. Gangadharan, A. Purandaran, K. Malathi, B. Subramanian, R. Jeyaraj and S. K. Jung, “From Data to Decisions: The Power of Machine Learning in Business Recommendations,” IEEE Access, vol. 13, pp. 17354-17397, **2025**.
4. Akhrorjon Akhmadjon Ugli Rakhmonov, Barathi Subramanian, Bahar Amirian Varnousefaderani, & Jeonghong Kim, “AED-Net: Attention-Based Detection Model for Disabled Signage Detection,” The Journal of Korean Institute of Communications and Information Sciences, 49(7), 976-982, **2024**.
5. A. A. U. Rakhmonov, B. Subramanian, B. Amirian Varnousefaderani, and J. Kim, “AONet: Attention network with optional activation for unsupervised video anomaly detection,” ETRI Journal, vol. 46, no. 5, pp. 890–903, **2024**.
6. Rakhmonov Akhrorjon Akhmadjon Ugli, Barathi Subramanian, Bekhzod Olimov, Jeonghong Kim, “Extensive knowledge distillation model: An end-to-end effective anomaly detection model for real-time industrial applications,” IEEE Access, Vol.11, pp. 69750-69761, **2023**.
7. Bekhzod Olimov, Barathi Subramanian, Rakhmonov Akhrorjon Akhmadjon Ugli, Jea-Soo Kim, Jeonghong Kim, “Consecutive Multi-scale Feature Learning-based Image Classification Model,” Scientific Reports, **2023**.
8. Barathi Subramanian, Jeonghong Kim, Mohammed Maray, Anand Paul, “Digital Twin Model: A Real-Time Emotion Recognition System for Personalized Healthcare,” IEEE Access, vol. 10, pp. 81155-81165, **2022**.
9. Barathi Subramanian, Bekhzod Olimov, Shraddha M Naik, Sangchul Kim, Kil-Houm Park, Jeonghong Kim, “An integrated MediaPipe-optimized GRU model for Indian sign language recognition,” Scientific Reports, vol. 12, pp. 1-16, **2022**.
10. Barathi Subramanian, Anand Paul, Jeonghong Kim, K-W-A Chee, “Metrics Space and Norm: Taxonomy to Distance Metrics,” Scientific Programming, **2022**.
11. Barathi Subramanian, Bekhzod Olimov, Jeonghong Kim, “Fast Convergence GRU Model for Sign Language Recognition,” Journal of Korea Multimedia Society, Vol. 25, pp. 1257-1265, **2022**.
12. M Junaid Gul, Barathi Subramanian, Anand Paul, Jeonghong Kim, “Blockchain for public health care in smart society,” Microprocessors and Microsystems, Vol. 80, pp. 103524, **2021**.

Conference proceedings (21)

1. Barathi Subramanian, Rathinaraja Jeyaraj, Jeanne Shen, et. al., “TRIAGE-MIL: Multi-Axis Instance Selection and Semantic Hypergraph Modeling for Survival Prediction from Whole-Slide Images,” accepted at MICCAI **2026**.
2. Rathinaraja Jeyaraj, Barathi Subramanian, Kapilya Gangadharan, Anand Paul, “Gesture2Music: A Low-Latency Real-Time Framework for Continuous Gesture-Driven Music Generation,” First International Workshop on Interactive Physical AI (IPA), The IEEE/CVF Conference on Computer Vision and Pattern Recognition CVPR **2026**.
3. Barathi Subramanian, Rathinaraja Jeyaraj, Anand Paul, “Contrast-Enhanced Gating in GRUs for Robust Low-Data Sequence Learning,” Workshop on Women in Computer Vision Proceedings Track, The IEEE/CVF Conference on Computer Vision and Pattern Recognition CVPR **2026**.
4. Barathi Subramanian*, Rathinaraja Jeyaraj*, Mitchell Nevin Peterson, Terry Guo, Nigam Shah, Curtis Langlotz, Andrew Y. Ng, Jeanne Shen, “STARC-9: A Large-scale Dataset for Multi-Class Tissue Classification for CRC Histopathology,” The Thirty-ninth Annual Conference on Neural Information Processing Systems Datasets and Benchmarks Track (NeurIPS) **2025**. *Equally contributed
5. Barathi Subramanian, Rathinaraja Jeyaraj, Songmi Noh, Mitch Peterson, Terry Guo, George Fisher, Jeanne Shen, "Generating Morphologically Diverse, Class-Balanced Training Datasets for Enhanced Histopathologic Tissue-Type Classification," Pathology Research Retreat, Department of Pathology, Stanford University, California, USA, **2025**.
6. Rathinaraja Jeyaraj, Barathi Subramanian, Songmi Noh, Mitch Peterson, Terry Guo, George Fisher, Jeanne Shen, "A Novel AI-Powered Preprocessing Framework for Maximizing Whole-Slide Image Dataset Quality for Machine Learning Applications," Pathology Research Retreat, Department of Pathology, Stanford University, California, USA, **2025**.
7. Barathi Subramanian, Rathinaraja Jeyaraj, Songmi Noh, Mitch Peterson, Terry Guo, George Fisher, Thomas Montine, Jeanne Shen, "A novel training sample collection framework for improving the performance of multi-tissue type classification in histopathology," 2nd Annual Congress of the Asian Society of Digital Pathology, (ASDP), India, **2025**.
8. Rathinaraja Jeyaraj, Barathi Subramanian, Songmi Noh, Mitch Peterson, Terry Guo, George Fisher, Thomas Montine, Jeanne Shen, "Artificial intelligence-based tile preprocessing for more effective whole-slide image tissue segmentation," 2nd Annual Congress of the Asian Society of Digital Pathology (ASDP), Mumbai, India, **2025**.
9. Rathinaraja Jeyaraj, Barathi Subramanian, Karnam Yogesh, Aobo Jin, Umit Karabiyik, and Hardik A Gohel, “YOLO v8 with Spatial Attention and FFT: A Novel Approach to Counter Face Spoofing Attacks in Smart Devices,” IEEE 3rd International Conference on AI in Cybersecurity (ICAIC), Houston, TX, USA, 2024, pp. 1-6, **2024**.

10. Barathi Subramanian, Rakhmonov Akhrorjon Akhmadjon Ugli, Jeonghong Kim, “ASN:Attention-Guided Siamese Network for Anomaly Detection in Few-Shot Learning,” KIICE, **2023**.
11. Akhrorjon Akhmadjon Ugli Rakhmonov, Barathi Subramanian, Taehun Kim, Jeonghong Kim, “Airy YOLOv5 for Disabled Sign Detection,” 14th International Conference on Ubiquitous and Future Networks-ICUFN (IEEE), pp.869-874, **2023**.
12. Barathi Subramanian, Rakhmonov Akhrorjon Akhmadjon Ugli, Bahar Amirian Varnousefaderani, Jeonghong Kim, “Telehealth 2.0:A Novel Framework for Real-Time Liveliness Detection and Mood Analysis,” 11th International Conference on Orange Technology-ICOT, & 19th International Conference on Intelligent Information Hiding and Multimedia Signal Processing IIHMSP, **2023**.
13. Barathi Subramanian, Rakhmonov Akhrorjon Akhmadjon Ugli, Taehun Kim, Jeonghong Kim, “LF-YOLOv5: An Improved and Lightweight YOLOv5 model for Disabled sign detection,” Korea software conference, Jeju, **2022**.
14. Rakhmonov Akhrorjon Akhmadjon Ugli, Barathi Subramanian, Jeonghong Kim “Disabled Sign Recogniton using single-shot detection,” KISC, **2022**.
15. Barathi Subramanian, Bekhzod Olimov, Jeonghong Kim, “Fast-convergence GRU model for Indian Sign Language Recognition,” Korea Multimedia society, Busan, **2022**.
16. Bekhzod Olimov, Barathi Subramanian, Jeonghong Kim, “Unsupervised Deep Learning-based End-to-end Network for Anomaly Detection and Localization,” 13th International Conference on Ubiquitous and Future Networks-ICUFN(IEEE), pp. 444-449, **2022**.
17. Barathi Subramanian, Anand Paul, Jeonghong Kim, Madhan Kumar Srinivasan, “Predictive Modeling and Mobility Pattern Analysis,” 9th International Conference on Orange Technology-ICOT (IEEE), pp. 1-4, **2021**.
18. Barathi Subramanian, Bekhzod Olimov, Jeonghong Kim, “Real-Time Hand gesture Recognition for Indian Sign Language using CNN with Deep Single-Shot Detector,” Korea Multimedia society, **2021**.
19. Barathi Subramanian, Bekhzod Olimov, Jeonghong Kim, “Real-Time Hand tracking system for Indian sign language gesture recognition,” 17th International conference on Multimedia Information Technology and Applications, Jeju, **2021**.
20. Bekhzod Olimov, Barathi Subramanian, Jeonghong Kim, “Deepmednet: Deep learning based medical image segmentation model,” DB-Pia, pp. 576-578, **2021**.
21. Bekhzod Olimov, Barathi Subramanian, Jeonghong Kim, “An efficient deep convolutional neural network for semantic segmentation,” 8th International Conference on Orange Technology-ICOT(IEEE), pp. 1-9, **2020**.

Patent (1)

1. Barathi Subramanian, Anand Paul, and Jeonghong Kim, “Digital Twin-Based Emotion Recognition System for Personalized Healthcare: Enhancing Emotional Well-Being Through Real-Time Monitoring and Treatment Strategies,” Indian Patent in Bio-medical Engineering, **2023**.

Professional Services

Co-organizer and Track Chair

- The International Conference on Recent Advances in Electronics, Communication, Computing, Automation, and Power (RECCAP 2026), IIT Palakad, India.
- North American Young Investigators Symposium on Mathematical Oncology 2026, Stanford University, California, USA.

Reviewer

- CVPR, NeurIPS, MICCAI, ACM-MM (2026)
- IEEE SMC Magazine (2023 — Present)
- IEEE Access (2022 — Present)
- Computer Animation and Virtual Worlds (2023)
- The International Journal of Advanced Manufacturing Technology (2022 – Present)
- IEEE Journal of Biomedical and Health Informatics (2023 – Present)
- Journal of Autonomous Intelligence (2023 – present)