

EDUCATION

Washington University in St. Louis

Doctor of Philosophy in Computer Science

St. Louis, MO, U.S.

2022 - August 2025

University of Kentucky

Master of Science in Electrical Engineering (GPA: 4.0/4.0)

Lexington, KY, U.S.

2018 - 2020

Nitte Meenakhshi Institute of Technology

Bachelors in Electronics and Communication Engineering (GPA: 9.54/10 - Gold Medalist)

Bengaluru, India

2012 - 2016

WORKING EXPERIENCE

Multimodal Vision Research Lab

Graduate Research Assistant

Washington University in St. Louis

August 2022 - Present

- Developed multi-modal deep learning frameworks for geospatial understanding of global soundscapes.
 - **Sat2Sound** (Under Review 2025): Developed a state-of-the-art soundscape mapping framework that leverages a Vision-Language Model (VLM) to enrich the semantic understanding of a location's soundscape, learns a shared codebook for fine-grained alignment, and enables retrieval-based, location-conditioned soundscape generation.
 - **PSM** (ACM Multimedia 2024): Extended GeoCLAP with a probabilistic, multi-scale, and metadata-aware embedding space for improved zero-shot soundscape mapping.
 - **GeoCLAP** (BMVC 2023): Proposed a tri-modal embedding space integrating satellite imagery, audio, and textual descriptions for zero-shot soundscape mapping at a global scale.
- Built large-scale ML-ready datasets:
 - **GeoSound**: A multi-resolution dataset combining satellite imagery, geotagged sounds, and textual sound descriptions.
 - **EarthSoundCaps**: A global dataset comprising ~2.5 million satellite images and ~10 million auditory and visual captions, covering the entire Earth, generated using a state-of-the-art multimodal LLM.
- Contributed to **RANGE** (CVPR 2025), a novel retrieval-augmented method for multi-resolution geolocation embeddings.
- Contributed to additional multimodal embedding spaces:
 - **Sat2Cap** (EarthVision 2024) and **GeoBind** (IGARSS 2024) for query-driven mapping.
 - **TaxaBind** (WACV 2025) for ecological applications.
- Contributed to frameworks for ecological modeling and visual classification:
 - **LD-SDM** and **BirdSAT** (WACV 2024) for species distribution modeling and fine-grained classification.
- Contributed to diffusion model based conditional generation methods:
 - **GeoSynth** (EarthVision 2024): A framework for controlled satellite image synthesis.
 - **MVPS** (Accepted to TMLR 2025): A framework for novel panoramic view synthesis using satellite imagery.
- Collaborated on the IARPA-funded **SMART** project:
 - Developed large-scale self-supervised learning (SSL) methods, including Masked Autoencoders (MAE), for remote sensing applications such as semantic change detection.

Valuation and Market Dynamics

Applied Scientist - Intern

Zillow Group

May 2024 - August 2024

- Explored directions for improving Zillow's flagship product, Zestimate, by incorporating a diverse set of features.
- Developed a multimodal model for sales price estimation, learning from both structured tabular data and floorplan images.
- The proposed multimodal model achieved approximately 3% improvement across all metrics compared to the baseline.

Lin Brain Lab

Graduate Research Assistant

University of Kentucky

August 2020 - August 2022

- Provided applied Machine Learning (ML) and data science support to advance Alzheimer's disease (AD) research while working on different modalities such as medical imaging, electronic health records, and genomics.
- Designed CNN and Vision Transformers (ViT) based models trained on MRI/PET imagery for AD prediction.
- Focusing on interpretability, designed CAT-XPLAIN, an inherently interpretable ViT model that uses causality in predictions to identify the most important image patches.
- Built ML models trained on genetics, electronic health records and imaging features for biomarkers discovery and early prediction of Alzheimer's disease.

Speech and Signal Processing Lab

Graduate Research Assistant

University of Kentucky

August 2018 - August 2020

- Performed analysis of articulatory differences in speech of native and non-native speakers of English.
- Built Automatic Speech Recognition (ASR) based Mispronunciation Detection and Diagnosis (MDD) framework. ASR was trained using Recurrent Neural Networks (RNN) on articulatory as well as acoustic features.

Kantipur Engineering College

Lecturer

Lalitpur, Nepal

April 2017 - July 2018

- Taught courses: Microprocessor, Instrumentation
- Designed and conducted lab on Digital Signal Processing (DSP), Microprocessor.

KEY SKILLS

- **Languages and Tools:** Python (fluent), Pytorch (fluent), Git (fluent), Docker (familiar), QGIS (familiar).
- **Research Interests and Relevant Courses:** Computer Vision, Multimodal Machine Learning, Deep Learning, Self-Supervised Learning, Generative AI, Geospatial AI, Data Science, Data Structures and Algorithms.

AWARDS AND ACHIEVEMENTS

- COMPEX Scholarship offered by the Indian Embassy in Nepal for undergraduate study in India, 2012–2016.
- ECE Gold Medal, 2016 for graduating with Rank 1 in the department.

PUBLICATIONS

Preprints:

- **Khanal Subash**, Sastry Srikumar, Dhakal Aayush, Ahmad Adeel and Jacobs Nathan, “Sat2Sound: A Unified Framework for Zero-Shot Soundscape Mapping,” arXiv:2505.13777, 2025.
- Xiong Zhexiong, Xing Xin, Workman Scott, **Khanal Subash** and Jacobs Nathan, “Mixed-View Panorama Synthesis using Geospatially Guided Diffusion,” arXiv:2407.09672, **accepted in Transactions on Machine Learning Research (TMLR)**, 2025, [Online] Available: <https://openreview.net/forum?id=yIUVRikhTL>.
- Sastry Srikumar, Xin Xing, Dhakal Aayush, **Khanal Subash**, Ahmad Adeel, and Jacobs Nathan, “LD-SDM: Language-Driven Hierarchical Species Distribution Modeling,” arXiv:2312.08334, 2024.
- **Khanal Subash**, Brodie Benjamin, Xing Xin, Lin Ai-Ling and Jacobs Nathan, “Causality for inherently explainable transformers: CAT-XPLAIN,” **Spotlight Presentation** at XAI4CV: Explainable Artificial Intelligence for Computer Vision (IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) Workshops), arXiv:2206.14841, 2022.

Published Conference Papers:

- Dhakal Aayush, Sastry Srikumar, **Khanal Subash**, Ahmad Adeel, Xing Eric and Jacobs Nathan, “RANGE: Retrieval Augmented Neural Fields for Multi-Resolution Geo-Embeddings,” IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2025.
- Sastry Srikumar, **Khanal Subash**, Dhakal Aayush, Ahmad Adeel and Jacobs Nathan, “TaxaBind: A Unified Embedding Space for Ecological Applications,” IEEE Winter Conference on Applications of Computer Vision (WACV), 2025.
- **Khanal Subash**, Xing Eric, Sastry Srikumar, Dhakal Aayush, Xiong Zhexiong, Ahmad Adeel and Jacobs Nathan, “PSM: Learning Probabilistic Embeddings for Multi-scale Zero-Shot Soundscape Mapping,” ACM Multimedia, 2024, doi: 10.1145/3664647.3681620.
- Dhakal Aayush, Ahmad Adeel, **Khanal Subash**, Sastry Srikumar, Kerner Hannah and Jacobs Nathan, “Sat2Cap: Mapping Fine-Grained Textual Descriptions from Satellite Images,” IEEE/ISPRS Workshop: Large Scale Computer Vision for Remote Sensing (EARTHVISION), 2024. **Best Paper Award**.
- Sastry Srikumar, **Khanal Subash**, Dhakal Aayush, and Jacobs Nathan, “GeoSynth: Contextually-Aware High-Resolution Satellite Image Synthesis,” IEEE/ISPRS Workshop: Large Scale Computer Vision for Remote Sensing (EARTHVISION), 2024.
- Dhakal Aayush, **Khanal Subash**, Sastry Srikumar, Ahmad Adeel and Jacobs Nathan, “GeoBind: Binding text, image, and audio through satellite images,” IEEE International Geoscience and Remote Sensing Symposium (IGARSS), 2024. **Oral Presentation**.
- Sastry Srikumar, **Khanal Subash**, Dhakal Aayush, Di Huang and Jacobs Nathan, “BirdSAT: Cross-View Contrastive Masked Autoencoders for Bird Species Classification and Mapping,” IEEE Winter Conference on Applications of

Computer Vision (WACV), 2024.

- **Khanal Subash**, Sastry Srikumar, Dhakal Aayush and Jacobs Nathan, "Learning Tri-modal Embeddings for Zero-Shot Soundscape Mapping," British Machine Vision Conference (BMVC), 2023.
- Xing Xin, Liang Gongbo, Zhang Yu, **Khanal Subash**, Lin Ai-Ling and Jacobs Nathan, "Advit: Vision transformer on multi-modality pet images for alzheimer disease diagnosis," IEEE International Symposium on Biomedical Imaging (ISBI), 2022, doi: 10.1109/ISBI52829.2022.9761584.
- **Khanal Subash**, Chen Jin, Jacobs Nathan and Lin Ai-Ling, "Alzheimer's Disease Classification Using Genetic Data," IEEE International Conference on Bioinformatics and Biomedicine (BIBM) Workshop, 2021, doi: 10.1109/BIBM52615.2021.9669730.
- Brodie Benjamin, **Khanal Subash**, Rafique Muhammad Usman, Greenwell Connor and Jacobs Nathan, "Hierarchical Probabilistic Embeddings for Multi-View Image Classification," IEEE International Geoscience and Remote Sensing Symposium (IGARSS), 2021, doi: 10.1109/IGARSS47720.2021.9554405.
- **Khanal Subash**, Johnson Michael T., Soleymanpour Mohammad and Bozorg Narjes, "Mispronunciation Detection and Diagnosis for Mandarin Accented English Speech," International Conference on Speech Technology and Human-Computer Dialogue (SpeD), 2021, doi: 10.1109/SpeD53181.2021.9587408.
- **Khanal Subash**, Johnson Michael T. and Bozorg Narjes. "Articulatory Comparison of L1 and L2 Speech for Mispronunciation Diagnosis," IEEE Spoken Language Technology Workshop (SLT), 2021, doi: 10.1109/SLT48900.2021.9383574.
- **Khanal Subash**, "Mispronunciation Detection and Diagnosis for Mandarin Accented English Speech," Theses and Dissertations–Electrical and Computer Engineering, 156, 2020, doi: 10.13023/etd.2020.340.