# Sahil Khose

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## RESEARCH INTERESTS

Computer Vision, Continual Learning, Zero-Shot Learning, Semi/Self-supervised Learning and NLP.
Solving deep learning problems using a limited (ideally zero) amount of data is what piques my interest.

## EDUCATION

**Georgia Institute of Technology, Atlanta, USA** Aug 2022 – May 2024
*MS in Computer Science*

**Manipal Institute of Technology, Manipal, India** 2018 – 2022
*B.Tech in Computer and Communication Engineering (Big Data Minor GPA: 10.0)* *CGPA: 8.56/10*

## EXPERIENCE

**Indian Institute of Science, Bangalore, India** Jul 2021 – Jul 2022
*AI Research Assistant* *Advisors – Dr. Suresh Sundaram & Dr. Chandan Gautam*

- Innovated solutions for various problems in the **Continual Generalized Zero-Shot Learning (CGZSL)** setting at the **Artificial Intelligence and Robotics Lab.**
- Worked on Sketch Based Image Retrieval, Domain Generalization and Object Detection in a CGZSL setup.

**Manipal Institute of Technology, Manipal, India** Apr 2021 – Jul 2022
*Medical AI Research Assistant* *Advisor – Dr. Harish Kumar JR*

- Developed a medical diagnosis system for **fovea segmentation** using semi-supervised segmentation.
- Worked on **macular degeneration classification** with interpretability for ophthalmology diagnosis.

**Project MANAS – AI Robotics Research Team, MIT, Manipal, India** Feb 2019 – May 2021
*AI Perception Developer*

- Built a UGV robot for the **27th Intelligent Ground Vehicle Competition** held in Michigan, USA.
- Worked on developing a **level 2-3 autonomy** car on Indian roads for the **Mahindra $1Million Challenge.**

## ACHIEVEMENTS

- **Project MANAS** stood **World Rank 1** at the **27th Intelligent Ground Vehicle Competition** (IGVC 2019).
- **IGVC 2019 Awards:** Grand Award - 1st (Lescoe Cup), Interoperability - 1st, Design - 2nd, Cybersecurity - 3rd.
- **Project MANAS** won the the **Mahindra $1Million Challenge (top 13 out of 153 teams in India)**.
- Top performer on Task 1 & 6 with special recognition on multi-task performance at SMM4H, **NAACL 2021**.
- Received the Best Paper Award at New In ML, **ICML 2022**.

## PUBLICATIONS

**1. Continual VQA for Disaster Response Systems**
*Under review GitHub | Paper* Sep 2022

- Authors: *Aditya Kane, V Manushree,* ***Sahil Khose***
- We use the **CLIP** architecture and evaluate its **zero-shot and linear classifier** performance on the FloodNet dataset, surpassing its previous supervised benchmarks.
- We address the bottleneck of gathering labels in disaster response situation and propose using 3 different experience replay algorithms for a **continual learning setup**.

**2. An Efficient Modern Baseline for FloodNet VQA**
***[Best Paper Award]*** *New in ML at* ***ICML 2022*** *GitHub | Paper* May 2022

- Authors: *Aditya Kane,* ***Sahil Khose***
- We design a simple and efficient VQA system on the FloodNet dataset achieving **state-of-the-art performance**.
- We revisit fundamental combination methods for VQA with **modern image and text feature abstraction models**.
- This simplified system requires significantly less **training and inference time** than modern VQA architectures.

### 3. Transformer based ensemble for emotion detection

***[Oral]*** *WASSA at* ***ACL 2022*** *GitHub | Paper (aclanthology)* Mar 2022

- Authors: *Aditya Kane, Shantanu Patankar,* ***Sahil Khose****, Neeraja Kirtane*
- Additional Links: *Experiments | Slides | Poster | Video*
- Developed ensemble based solution consisting of multiple ***ELECTRA*** and ***BERT*** models.
- Proposed methods for ***synthetically generating datasets*** to mitigate class imbalance.
- Studied the behaviour of our models on various raw and synthetically generated datasets.

### 4. AMD Classification and Fovea Segmentation using Semi-Supervised Learning

*Under Review* Oct 2021

- Authors: ***Sahil Khose****, Ankita Ghosh, Harish Kumar J. R.*
- Faculty Advisor: *Dr. Harish Kumar J. R.*
- Developed a semi-supervised segmentation pipeline to train on **484** images for fovea segmentation.
- Designed a interpretable classification system on a dataset of **627** datapoints. The task being age-related macular degeneration with an imbalance of **1:5:5**. We use **Score-CAM, SS-CAM, and IS-CAM** to visualize the activation maps.

### 5. A Studious Approach to Semi-Supervised Learning

***[Poster]*** *ICBINB at* ***NeurIPS 2021*** *GitHub | Paper* Sep 2021

- Authors: ***Sahil Khose****, Shruti Jain, V Manushree*
- Additional Links: *Poster*
- Performed **distillation** for **semi-supervised learning** producing better and smaller models with lesser labels for real-time deployment. Decreased both **size and inference time** without hurting the performance.
- We experimented on: EfficientNet-b5, ResNet18, and MobileNet-V3-Large to demonstrate the benefit of **model compression** on **four label splits**, highlighting the semi-supervised advantage and model optimization.

### 6. Extraction of Color Information from Images for Generation of Colored Outlines and Sketches

***[Paper]*** *ML for Creativity and Design at* ***NeurIPS 2021*** *GitHub | Paper* Aug 2021

- Accepted: ***1. [Paper]*** *ML for Creativity and Design,* ***2. [Poster]*** *Deep Generative Models and Downstream Applications,* ***3. [Paper]*** *CtrlGen: Controllable Generative Modeling in Language and Vision,* ***4. [Oral]*** *New in ML at* ***NeurIPS 2021****.*
- Authors: *V Manushree, Sameer Saxena, Parna Chowdhury, Manisimha Varma, Harsh Rathod, Ankita Ghosh,* ***Sahil Khose***
- Additional Links: *Demo | Poster | Slides*
- Applied image processing techniques and **unsupervised learning** to quantize and extract colors in images and render sketches with colored outlines.
- Used **conditional GANs** for image to colored-sketch generation with the help of colorspace manipulation.

### 7. Semi-Supervised Classification and Segmentation on High Resolution Aerial Images

***[Spotlight Paper]*** *Tackling Climate Change with ML at* ***NeurIPS 2021*** *GitHub |Paper* May 2021

- Authors: ***Sahil Khose****, Abhiraj Tiwari, Ankita Ghosh*
- Additional Links: *Demo | Blog | YouTube | Video*
- Handled a dataset of 1450 images with just **25% labelled** data and a **class imbalance of 1:6.**
- ResNet18 with our implemented semi-supervised classification pipeline fetched **96.70% test** accuracy beating the best model of the **FloodNet paper** by a **huge 3% margin** with **less than half** the parameters.
- Implemented a **semi-supervised multi-class segmentation** pipeline for 10 class segmentation. DeepLabv3+ with EfficientNet-B3 backbone fetched us 52.23% mIoU on the test set.
- Analytically and visually analyzed our performance for segmentation on multiple architectures like **UNet, PSPNet, DeepLabV3+** with and without **pseudo label** based semi-supervised learning.

### 8. BERT based Transformers lead the way in Extraction of Health Information from Social Media

***[Oral]*** *Published in proceedings of* ***NAACL 2021*** *at SMM4H workshop GitHub | Paper (aclanthology)* Apr 2021

- Authors: *S Ramesh,* ***Sahil Khose****, Abhiraj Tiwari, Parthivi Choubey, Saisha Kashyap, Kumud Lakara, N Singh, Ujjwal Verma*
- Faculty Advisor: *Dr. Ujjwal Verma*
- Additional Links: *Poster | Slides*
- **ADE classification**: Handled a **1:13 class imbalance** dataset. Trained *RoBERTa* and *BioBERT*. Achieved valid F1: 85% test F1: 61%. *(ADE: Adverse Drug Effects)* **[Rank: 1]**
- **ADE span detection**: *RoBERTa* based NER pipeline. Achieved valid F1: 54% test F1: 50%.**[Rank: 2]**
- **COVID classification**: *RoBERTa, DeBERTa, Covid-Twitter BERT, BERTweet, and ensemble* were trained for the 3 class classification problem. Achieved valid F1: 99% test F1: 94%. **[Rank: 2]**

## Projects

**Do Counterfactual Winning Lottery Tickets Exist?** Sep 2022 - Present

- We question the existence of “Counterfactual Winning Lottery Tickets” and hypothesize that if they do, they may obtain different predictions for the same datapoint.
- We aim to understand and redefine the meaning of "winning" and see how these different predictions help us do that.

**Limited Supervision Architecture Zoo *GitHub*** Sep 2022 - Present

- Every week we implement **vital components** of state-of-the-art architectures for limited supervision under **2 hours**.
- The aim is to get a deeper understanding of the architectures. We read the paper but refrain from looking at the code.
- We have implemented **ViT, GAN, CycleGAN** so far. We plan to implement SimCLR, DINO and MAE in the near future.

**Zero-Shot Domain Generalization: Unseen Classes in Unseen Domains** Jan 2022 - Apr 2022

- Used **CLIP** model features and optimized the **CNZSL** architecture on DomainNet to address the joint **domain generalized zero-shot learning** setting.
- Evaluated on **six different unseen domains** under **three different zero-shot** settings and the proposed solution outperforms state-of-the-art models in this problem setting in most of the domains.

**Self-Driving Car and AGV – Project MANAS *GitLab* | *Website*** Feb 2019 – May 2021

- Successfully implemented **Lane Detection, Speed Bump Detection, Driving Imitation System, Depth Map Generation** using multiple cameras and LiDAR input using Deep Learning for our autonomous ground vehicle and the self-driving car.

**StackGAN for text to image generation *GitHub*** Oct 2020

- Implemented the **StackGAN** (2 stages GAN) architecture from scratch in PyTorch with enhanced BERT data representations for synthesizing photo-realistic bird images from their textual descriptions.

**QANet for SQuAD 2.0 (Question-Answering) *GitHub*** Sep 2020

- Implemented the **QANet** architecture from scratch in PyTorch consisting exclusively of convolution and self-attention, achieving **13x** faster train & **9x** faster inference than the BIDAF model (previous SOTA).

**Stock Prediction using Hyper Graphs *GitHub*** Aug 2020

- Developed a Hypergraph structured dataset and built a Hypergraph NN based architecture with **Hypergraph CNN, BERT, LSTM and attention network** for stock prediction of 500 stocks over time.

**Neural Machine Translation *GitHub* | *Demo*** Jul 2020

- Built a Neural Machine Translation model using a seq2seq bi-LSTM architecture with attention and hybrid character-word level language modelling. Achieved **37 BLEU** on Spanish-English translation.

## Technical Skills

**Languages**: Python, C++, Java, C
**Tools and Libraries**: PyTorch, NumPy, OpenCV, Matplotlib

## Extracurricular

**FruitPunch AI – AI expertise head** Aug 2021 – Present

*Established the first international chapter of FruitPunch AI, a non profit organization **headquartered in Europe**. Currently engaged in building the community and promoting AI for social good initiatives*

**YouTube Channel – Online Educator** Jun 2021 – Present

*Conducts **presentations and explanations** on cutting edge research papers in the field of AI.*

**NAACL 2021 reviewer** Mar 2021

*Reviewed multiple research papers as a part of the review committee for SMM4H Workshop.*

**Research Society Manipal – AI division mentor** Nov 2020 – Present

***Mentoring** and **guiding** several students to pursue research in the field of Deep Learning.*

**Medium | WordPress | Website Feed** Oct 2018 – Jul 2022

*Documented my BTech college journey with a series of tech and non-tech **blog posts**.*