Bavesh Balaji

Sports Analytics · Computer Vision · Cognitive Modelling · Algorithms
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Summary

I would ultimately like to develop models that go one step beyond effectively approximating complex, non-linear processes and truly comprehend tasks focusing on player identification and performance evaluation for sports. Thus, as a researcher at the Sports Analytics Research Group, Vision and Image Processing Lab, UWaterloo I am currently working towards enhancing the visual understanding of human pose estimates specifically for sports analysis (ice-hockey) using transformers and CNN techniques.

Education

University of Waterloo
Ontario, Canada

MASc in Systems Design Engineering
Sept 2022 - Present

- **Research:** 2D Player Pose Estimation and Identification for Monocular Ice-Hockey Videos.
- **Supervisor:** Dr. David A Clausi, Dr. Sirisha Rambhatla.
- **Courses:** Graphical Deep Learning, Advanced Image Processing, Systems Design Theory.
- **CGPA:** 92.5/100 (4.0/4.0)

Indian Institute of Information Technology- Kancheepuram
Chennai, India

B.Tech. in Computer Science Engineering
July 2018 - April 2022

- **Research:** Multimodal Emotion Recognition from Videos and EEG Data.
- **Supervisor:** Dr. Masilamani V.
- **Courses:** Advanced Data Structures and Algorithms, Discrete Mathematics, Digital Analysis of Algorithms, Linear Algebra, Pattern Recognition, Operating Systems, Probability Theory, Computer Architecture, Embedded Systems.
- **CGPA:** 9.04/10

Bachelor's Thesis

Indian Institute of Information Technology, Kancheepuram
Chennai, India

Supervisor: Dr. Masilamani V
Nov 2021 - April 2022

- A robust emotion recognition model was proposed leveraging transformer and convolutional deep networks.
- A multimodal setup using both videos and EEG data was established and extensive experimentation was conducted.
- Knowledge Distillation was incorporated to facilitate faster learning for transformer models from soft labels generated from pre-trained convolutional neural networks.

Area of Expertise

Programming Tools	**: C++, Python, C, Java, HTML, CSS**
ML Tools	**: PyTorch, TensorFlow, DarkNet, OpenCV, Matplotlib, NumPy, Keras, Scikit**
Operating System	**: Linux Ubuntu, Windows**
MLOps	**: Neptune, Hydra, Weights and Biases**

Honors & Awards

Graduate Research Fellowship, University of Waterloo, Canada
ACM-International Collegiate Programming Competition, Represented my college and ranked 222nd in Gwalior-Pune regionals and 342nd in Amritapuri regionals
Google Kickstart, Secured a global rank of 742
Google CodeJam, Secured rank 2027 in 2nd round

Competitive Programming

Codeforces, Max rating of 1644 as Expert (top 4% in India)
Codechef, 5-star rated (top 0.9% in the world)
Atcoder, Max rating of 1383 (top 10% in the world)

Research Experience

Indian Institute of Technology
Roorkee, India

Computer Vision Research Intern, Parimal Lab
Nov 2021 – May 2022

- Worked under Dr. Partha Pratim Roy on multi-model emotion recognition from facial images, videos and other types of data such as EEG and ECG signals.
- Worked extensively on state-of-the-art classification models such as Vision Transformer, ConvNeXt, and Residual Masking Net and implemented them from scratch in PyTorch.
- Also worked on emotion classification using topological maps(an accurate mapping of a person's brain and the various signals in the different parts of the brain), which were created from EEG signals.
- **Supervisors:** Dr. Partha Pratim Roy

Quantrium Tech.
Chennai, India

Computer Vision Intern
May 2021 – Jul 2022

- Performed object detection on images from camera-trap using Microsoft's MegaDetector.
- Worked in Google Cloud Platform and built a deep learning-based classifier to classify over 200 species in images from camera traps using Efficient Net-b5 and increased the accuracy from 85% to 89%.
- Worked on tracking of fishes from highly occluded and low-frame rate videos.
- Worked on detection and segmentation of coral reefs from underwater images.
- Participated in the Great Barrier Reef Kaggle competition and procured a rank of 330.
- Currently working on AI PARAS, a project that helps shopkeepers identify the sweet spots in their brick and mortar stores and give them the analysis of how the placement of objects impacts their sales, using computer vision and image processing techniques.
- **Supervisor:** Mr. Anidhya Bhatnagar

CogXRLabs, Indian Institute of Technology
Roorkee, India

Computer Vision Research Intern
October 2020 - April 2021

- Working on classification and localization of oral cancer from mobile images.
- Worked on 2 different kinds of localization, bounding boxes, and different types of gradCAM visualizations.
- Used the latest object detectors such as YOLOv7 to detect the bounding boxes.
- Created a demo app to pitch to the investors and deployed the model using streamlit and huggingface spaces.
- Also worked on speech-to-text conversion using wav2vec and skin cancer detection from histopathological images.

Projects

End-to-End Pose Estimation from Monocular Ice-Hockey Videos
Sep 2022 - Dec 2022

University of Waterloo

- Implemented an end-to-end pipeline for 2D and 3D pose estimation of players which can subsequently be used for action recognition.
- Performed an extensive comparative study of the different transformer and convolutional architectures used for 2D pose estimation, such as HRNet, MSPN, TransPose, and DARK.
- Proposed a novel architecture for 3D pose estimation from the 2D pose generated by incorporating convolutional blocks into transformer architectures and achieved comparable results to the state-of-the-art models.
- Used knowledge distillation to create soft ground truths from existing pre-trained models such as STGCN(graph-based pose estimator) to disentangle the problem of lack of 3D ground-truth data.

POSIX Path Tracer
Sep 2020 – Oct 2020

Indian Institute of Information Technology, Kancheepuram

- Developed a primitive path tracer showcasing the effects of Global Illumination in a hardcoded scene description illuminated by an existing light source using C++ and PThreads.
- Employ the Russian roulette algorithm to terminate illumination and avoid pure white in cases where the light coming from the source does not diminish even after a lot of bounces
- Demonstrated the variance of render quality with respect to change in samples per pixel by conducting thorough and comprehensive experiments.

Mask Detection
Jan 2020 – April 2020

Indian Institute of Information Technology, Kancheepuram

- Used state-of-the-art object detection algorithms such as YOLO-v4 to detect whether people have worn masks or not.
- Incorporated detection in videos by utilizing OpenCV for pre-processing for videos.

Writer-Independent Offline Signature Verification
Jul 2022 – Aug 2022

Quantrium Tech.

- Re-implemented the SigNet paper to understand the fundamentals of one-shot Learning.
- Leveraged contrastive learning to differentiate 2 signatures from each other.
- Incorporated Convolutional Siamese Networks to perform one-shot learning and predict if 2 signatures are same on unseen signatures.

Attendance Management System
May 2020 – Aug 2020

Indian Institute of Information Technology, Kancheepuram

- Designed a portal for faculty and students with designated accounts for each person where the faculty can enter the attendance of each student for every course they teach and check the attendance of every student. The students can view their attendance for every course they've taken and can also communicate with other students in a particular course in common chatrooms.
- Utilized ReactJS for building the front-end along with redux for state management and Axios to communicate with REST API.
- Used NodeJS to create the back-end server and expressJS to build the REST API.
- Also incorporated BCryptJS for securing passwords.

CoDoH
Jan 2020 – April 2020

Indian Institute of Information Technology, Kancheepuram

- Used machine learning to build two statistical models, one for classifying network traffic as DoH vs non-DoH, and the other for classifying benign DoH vs Malicious DoH.

Declaration

- **I, Bavesh Balaji, affirm that the aforementioned information is true to my knowledge, as of Feb 22nd, 2023.**
- **References available on request.**