Aayush Kumar Chaudhary

Ph.D. in Imaging Science

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Research Interests: Image processing, computer vision, machine learning (deep learning), human computer interaction, eye-tracking, human vision

EDUCATION

Doctor of Philosophy, Imaging Science (Degree conferred Date: May 06, 2022) **Aug 14, 2016 – Apr 15, 2022**
Rochester Institute of Technology Rochester, New York

Area of focus: Image Processing, Machine Learning and Computer Vision
Relevant courses: image processing and computer vision, deep learning for vision, AI explorations, multiview geometry, human visual system, Bayesian statistics for machine learning, fourier methods for imaging, radiometry, optics for imaging
Dissertation: Deep into the Eyes: Applying Machine Learning to improve Eye-Tracking

Bachelor of Engineering (B.E.), Electronics and Communication Engineering, Pulchowk Campus, I.O.E., Tribhuvan University **Sep 12, 2010 – Aug 31, 2014**
Kathmandu, Nepal
Thesis: Teleoperation of Mobile Robotic Arm Through Imitation of Human Arms Movement (University Rank: 1st/5000)

WORK EXPERIENCE

Apple Inc. **Cupertino, California**
Display Pipeline Engineer (Display Team) June 26, 2023 – Present
- Developing innovative solutions to solves issues or enable new features by modifying the display system behavior and/or enhanced or new algorithms.

Microsoft Corporation **Redmond, Washington**
Scientist II (Mixed Reality) April 25, 2022 – April 10, 2023
- Designing novel ML solutions to improve eye tracking/ iris recognition.
- Analysis on reducing the domain gap of the synthetic dataset to help train ML models.
- Improved the visualization tools to identify the failure cases in eye tracking.
- Worked on ONNX runtime for possible deployment in hardware.

Qualcomm Technologies, Inc. **Virtual – New York**
Interim Engineering Intern (Machine Learning for Image Processing (Camera Team)) June 14, 2021 – Sept 17, 2021
- Designing neural network algorithms to solve research problems related to image restoration, and enhancements for improving photographs. (super-resolution and denoising)
- Focused on constructing efficient solutions using integer arithmetic processors.

Multidisciplinary Vision Research Laboratory, RIT, *Research Assistant* **Rochester, New York**
May 15, 2017 – April 15, 2022
- Worked in the field of using image processing, machine learning and computer vision to improve eye-tracking in supervision of Prof. Dr. Jeff Pelz
- Contributed to 3 journal and 7 conference proceedings in major venues for the field of eye tracking (segmentation, object tracking, gaze estimation, privacy, temporal synthetic dataset, blink modeling)

Chester F. Carlson Center for Imaging Science, RIT **Rochester, New York**
Teaching Assistant Aug 14, 2016-May 14, 2017
(Undergraduate Courses Assisted: Vision and Psychophysics, Linear Methods of Imaging)

Samsung India Electronics Pvt. Ltd (SIEL, Nepal branch) **Kathmandu, Nepal**
Senior Engineer (Smart phones performance testing and validation (METI team)) Feb 12, 2015-July 7, 2016
- My contribution in Q1'2016 was recognized with a performance award
- Contract role for SIEL under Suvidhasewa (Nov 20, 2014 – Feb 11, 2015)

SKILLS

Programming languages	**Python, Matlab**, **C++**, C
Packages	**PyTorch, TensorFlow, Scikit-Learn, OpenCV, Azure ML,** VisualSFM
Eye trackers	HoloLens, Pupil Labs eye trackers, custom-made remote eye trackers with mirrorless cameras
Miscellaneous	Human subjects research, robotics, circuit design tools, photography (iris)

RESEARCH EXPERIENCE

Gaze Estimation – (iris-based, Kalman filter, human-subjects, experiment design, calibration, 2D/3D modeling)

- Study of feasibility of iris features based gaze estimation (optical flow based on hand-crafted features)
- Developed a new approach of incorporating regression-based models with machine learning based approaches (based on proposed modified Kalman filter to disentangle useful pieces of information from two independent sources (one precise but drifting signal, and another accurate but noisy signal)
- Improved the precision and accuracy of eye trackers
- Designed and tested eye tracking hardware setup for study of various eye movements for human subjects

Segmentation – (image processing/computer vision based, supervised, semi-supervised, temporal)

- Improved the robustness of eye-parts segmentation with memory efficient models and effective domain-specific augmentations and loss functions
- Designed novel end-to-end framework for ellipse segmentation on eye-parts
- Proposed new frameworks for semi-supervised segmentation of eye-parts
- Demonstrated the effectiveness of temporal and semi-supervised segmentation for improving eye tracking.

Privacy in eye videos

- Designed a novel approach to preserve privacy in the eye videos without degrading eye tracking accuracy.

Synthetic dataset for eye-tracking applications

- Led/collaborated with multiple research labs in RIT to introduce a synthetic eye image generation platform for eye-tracking applications (https://cs.rit.edu/~cgaplab/RIT-Eyes/)
- Designed a novel data driven approach to generate temporal sequence of synthetic eye videos based on real gaze dynamics and modelling the blinks in 3D eyeball space

PUBLICATIONS

(equal contribution)*

JOURNAL ARTICLES

[J.3] **Chaudhary, A. K.**, Nair N., Bailey, R., Pelz J., Talathi S., Diaz G. "Temporal RIT-Eyes: From real infrared eye-images to synthetic sequences of gaze behavior" *(TVCG' 2022) (ISMAR 2022)*

[J.2] Kothari, R.*, **Chaudhary, A. K.*,** Bailey, R. J., Pelz, J., Diaz, G. "EllSeg: An Ellipse Segmentation Framework for Robust Gaze Tracking". *IEEE Transactions on Visualization and Computer Graphics (TVCG '2021) (IEEE-VR 2021) (oral) [Top 11 best papers in Journal Track]*

[J.1] **Chaudhary, A. K.** & Pelz, J. "Motion tracking of iris features to detect small eye movements". *Journal of Eye Movement Research (JEMR 2019)*

CONFERENCE PROCEEDINGS

[C.7] **Chaudhary, A. K.** & Pelz, J. "Enhancing the precision of remote eye-tracking using iris velocity estimation". *Eye Tracking Research & Applications (ACM-ETRA 2021)*

[C.6] **Chaudhary, A. K.***, Gyawali, P.K.*, Wang, L., Pelz, J. "Semi supervised learning for eye image segmentation". *Eye Tracking Research & Applications (ACM-ETRA 2021)*

[C.5] Nair, N., Kothari, R., **Chaudhary, A. K.,..,** Bailey, R. J. "RIT-Eyes: Rendering of near-eye images for eye-tracking applications". *Symposium of Applied Perception (ACM-SAP 2020) (oral)* ***[Best Paper Honorable Mention]***

[C.4] **Chaudhary, A. K.** & Pelz, J. 2020. "Privacy-Preserving Eye Videos using Rubber Sheet Model". *Eye Tracking Research & Applications (ACM-ETRA 2020)*

[C.3] Nair, N., **Chaudhary, A. K.,** Kothari, R., Diaz, G., Pelz, J., Bailey, R. "RIT-Eyes, realistically rendered eye images for eyetracking applications". *Eye Tracking Research & Applications (ACM-ETRA 2020)*

[C.2] **Chaudhary, A. K.*,** Kothari, R.*, Acharya., M.*, Dangi., S,.., Pelz., J. "RITnet: Real-time Semantic Segmentation of the Eye for Gaze Tracking". *IEEE/CVF International Conference on Computer Vision Workshop (ICCVW-2019) (oral) [Semantic Segmentation Challenge: Winner]*

[C.1] **Chaudhary, A. K.** "Motion tracking of iris features for eye tracking" *(ACM-ETRA 2019)*

SCHOLARSHIPS, AND AWARDS

Professional Achievement

2016 **Performance Award in recognition of High Performance for Q1'2016**, Samsung (SIEL)

Academic Achievement

2019 **Prof. F.N.Trofimenkoff academic achievement award,** a prestigious award given to one student each year by Department of Electronics and Computer Engineering, Pulchowk Campus, IOE (DoECE) for academic success during undergraduate studies.

2019 **Winner of Facebook OpenEDS competition.** Our model is memory efficient and achieves the state-of-the-art results on the 2019 OpenEDS Semantic Segmentation challenge.

2015 **NCell Excellence Award,** an award for being the overall topper of DoECE

2010-14 **University Rank 1st (Engineering Stream),** Rank First in All Bachelor's Degree programs of I.O.E. Tribhuvan University among more than 5000 engineering students.

2014 **NCell Scholarship Award,** Third-year topper of DoECE

2010 **Nepal Board Topper,** Scored the highest score in the country in Higher Secondary Education Board (12th grade) Science faculty.

Merit Scholarship

2016-22 **RIT Ph.D. Scholarship/Assistantship,** Financial Support for Ph.D. studies at RIT.

2010-14 **College Fellowship,** Awarded for outstanding academic performance in each semester of Bachelor of Engineering by I.O.E., Pulchowk Campus.

2010-14 **Full Academic Scholarship, a**warded to pursue B.E. at I.O.E, Pulchowk Campus based on nationwide competitive examination.

Activities and Leadership

2014 **Coordinator, LOCUS 2014 (Technological Event) -** Coordinated and organized the 11th national technological festival- the biggest technological festival of the country for DoECE and Department of Electrical Engineering**.**

2013 **Secretary, Amateur Radio Club,** A licensed Ham-Radio Operator

2013 **Team Member, ABU Robocon 2013, Vietnam -** Integral part of the hardware team (designing and building circuit boards) for the both manual and automatic robot that represented Nepal in the Asia-Pacific Broadcasting Union (ABU) Robocon 2013, Vietnam.

2013 **Secretary, Electronics Club -** Organized crash course to freshmen regarding Electronics circuits and helped to launch the first magazine of Electronics Club 'Graphene'.

2018 **IdeaLab -** Presented TUBBLE, an engaging Toy for Active Kids.

2014 **Child App Competition -** Presented a social interacting app 'Beautiful Minds' for autistic children and was one of the finalists of the Child App Competition. It was organized by Microsoft Innovation Center (Nepal) and UNICEF Nepal.

Miscellaneous

Poster

- Semi supervised learning for eye image segmentation -(ETRA'21)
- Enhancing the precision of remote eye-tracking using iris velocity estimation – (ETRA'21)
- Privacy-Preserving Eye Videos using Rubber Sheet Model – (ETRA'21)
- RITnet: Real-time Semantic Segmentation of the Eye for Gaze tracking (Workshop on Eye Tracking for VR and AR, ICCV'19)
- Motion Tracking of Iris Features for Eye Tracking – (ETRA'21)
- Motion Tracking of Iris Features to Detect Small Eye Movements – (Graduate Showcase, RIT'18)

Talk

- Presented work on Eye-Tracking and Temporal RIT-Eyes on Dr. David Zee's weekly virtual ocular motor/ vestibular lecture series at John Hopkins University School of Medicine (Invited Talk)
- Invited talk on 'Introduction to Machine Learning' in 3rd Nepal Winter School in AI (2021)
- Temporal RIT-Eyes: From real infrared eye-images to synthetic sequences of gaze behavior (ISMAR TVCG 2022)
- RIT-Eyes: Rendering of near-eye images for eye-tracking applications (ACM-SAP '20 (virtual))
- RITnet: Real-time Semantic Segmentation of the Eye for Gaze tracking (ICCV '19, Workshop on Eye Tracking for VR and AR)

Professional Services

Reviewer

[Journals] - Journal of Eye Movement Research (JEMR), Imaging Science Journal (IMS), International Symposium on Augmented and Mixed Reality (ISMAR), Computer Methods and Programs in Biomedicine Update, IEEE Micro, Behavioral Research Methods (BRM)

[Conferences] - Eye Tracking Research and Applications (ETRA), Pattern Analysis and Applications (PAAA)

[Workshops] - EPIC@ICCV 2021, FAIR@MICCAI 2021

[One recognition for ETRA 2020 Full Papers: Special Recognitions for Outstanding Reviews]

Judge, LOCUS 2016 (Technological Event)

- Represented Samsung (SIEL, Nepal branch) as one of the main judges of the event Samsung Galaxy App Quest conducted to promote application development in Nepal.

Mentor

- High school students (2019, 2020)
- Actively mentoring and working closely with numerous undergraduate and graduate level students on multiple projects related to eye tracking