Aayush Kumar Chaudhary

Ph.D. in Imaging Science

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

**EDUCATION**

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| **Doctor of Philosophy,** Imaging Science  Rochester Institute of Technology | **2016 – Apr 2022**  Rochester, New York |
| **Area of focus**: eye tracking methodology (image processing and machine learning)  Relevant courses: image processing and computer vision, deep learning for vision, AI explorations, multiview geometry, human visual system, Bayesian statistics for machine learning  **Dissertation:** [Deep into the Eyes: Applying Machine Learning to improve Eye-Tracking](https://search.proquest.com/openview/728375b3fc9d5c0c6523b84ecd0eca60/1?pq-origsite=gscholar&cbl=18750&diss=y) | |
| **Bachelor of Engineering (B.E.),** Electronics and Communication Engineering, Pulchowk Campus, I.O.E., Tribhuvan University  **(University Rank: 1st 85.47%)** [Engineering Stream] | **2010 – 2014**  Kathmandu, Nepal |
| **Thesis:**Teleoperation of Mobile Robotic Arm Through Imitation of Human Arms Movement | |

**WORK EXPERIENCE**

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| **Microsoft Corporation**  Scientist II (Mixed Reality, Eye Sensing)   * Designing novel solutions to improve eye tracking/ iris recognition. * Analysis on reducing the domain gap of the synthetic dataset. * Improved the visualization tools to identify the failure cases in eye tracking. | **Redmond, Washington**  April 2022 – Current |
| **Qualcomm Technologies, Inc.** Interim Engineering Intern (Machine Learning for Image Processing (Camera Team))   * Designing neural network algorithms to solve research problems related to image restoration, and enhancements for improving photographs. * Focused on constructing efficient solutions using integer arithmetic processors. | **Virtual – New York**  June 2021 - Sept 2021 |
| **Chester F. Carlson Center for Imaging Science, RIT**  Teaching Assistant  (Undergraduate Courses Assisted: Vision and Psychophysics, Linear Methods of Imaging) | **Rochester, New York**  Aug 2016-May 2017 |
| **Samsung India Electronics Pvt. Ltd (SIEL, Nepal branch)**  Senior Engineer (Smart phones performance testing and validation (METI team)) | **Kathmandu, Nepal**  Nov 2014-July 2016 |
| * My contribution in Q1’2016 was recognized with a performance award | |

**SKILLS**

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| 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 (Kicad, Proteus), photography (iris) |

**RESEARCH EXPERIENCE**

**Multidisciplinary Vision Research Laboratory, RIT, Research Assistant**

Advisor: Dr. Jeff PelzJune 2017 – April 2022

**Gaze Estimation**

* Study of feasibility of iris features based gaze estimation
* 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**

* Improved the robustness of eye-parts segmentation with memory efficient models.
* 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 concept for a novel approach to preserve privacy in the eye videos without degrading the accuracy of eye trackers

**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)*

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| ***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**

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| *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,** aprestigious 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. |
| 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**

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| 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. |
| 2013/14 | **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**

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| **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) |
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| **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) * 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) |
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| **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 |
| *[Conferences]* - Eye Tracking Research and Applications (ETRA), Pattern Analysis and Applications (PAAA) |
| *[Workshops]* - EPIC@ICCV 2021, FAIR@MICCAI 2021 |
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| ***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 |