

# Aman Goyal

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## EDUCATION

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**National Institute of Technology, Kurukshetra**

*Bachelor of Technology in Computer Engineering*

Kurukshetra, India

July 2017 – June 2021

## PUBLICATIONS

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- *PC2L: PCA Continual Learning*  
S. Behpour, P. Behpour, **A. Goyal**, R. Kang, M. Xu.  
Under Review at IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2022, New Orleans, Louisiana
- *Identifying Motorcycle Violations on Unconstrained Roads with Curriculum Learning, Occlusion Regressor, and Trapezium Regressor*  
**A. Goyal**, D. Agarwal, R. Kiran, R. Saluja, C.V. Jawahar.  
Under Review at Top Tier Conference (Level: A1)
- *Multimodal Emotion Recognition in Polish.*  
K. Rupaulhia, **A. Goyal**, A. Saini, A. Shukla, S. Swaminathan.  
Accepted in IEEE International Conference on Multimedia Big Data (BigMM), 2020, New Delhi, India
- *Blog Post on Quasi-Dense Similarity Learning for Multiple Object Tracking*  
**A. Goyal.**  
Under Review at International Conference on Learning Representations (ICLR) 2022

## RESEARCH EXPERIENCE

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**Xulab, Carnegie Mellon University**

June 2021 – November 2021

*Research Intern*

*Pittsburgh, USA*

- Worked under the guidance of [Prof. Min Xu](#) and [Dr. Sima Behpour](#) on projects based on continual learning.
- Formulated and implemented a novel regularization based approach for continual learning which uses principal vectors to reconstruct the orthogonal projection matrix.
- Implemented several state-of-the-art methods such as *Dynamically Expandable Networks*, *Orthogonal Weight Modification* and *Layerwise Optimization by Gradient Decomposition* across various datasets and environments .
- **Our work is currently under review at CVPR 2022.**
- Worked on setting up high performance clusters for the lab's GPU server.

**Optimization and Trustworthy ML Group, Michigan State University**

September 2021 – Present

*Research Intern*

*East Lansing, USA*

- Working with [Prof. Sijia Liu](#) on compression of object detection and tracking models for autonomous vehicles.
- Proposed a novel lightweight backbone for integration with state-of-the-art method *QDTrack*.
- Achieved a 30% increase in accuracy and a 63-fold reduction in size as compared to the *QDTrack* model variants with *Resnet-50* and *Resnet-101* backbones. All models were trained on *BDD100K Detection* dataset.
- Developed a lightweight backbone using feature-based knowledge distillation technique with *Resnet-50* as teacher network. The knowledge transfer took place on *BDD100K Detection* dataset.
- **Proposed techniques are intended to be presented in ICML 2022.**

**Centre for Visual Information Technology, IIIT Hyderabad**

February 2021 – September 2021

*Applied Research Fellow, Mobility Group*

*Hyderabad, India*

- Worked under the guidance of [Prof. Ravi Kiran](#) and [Prof. C.V. Jawahar](#) on a novel solution to detect helmet and triple riding violations on unconstrained roads.
- Designed and implemented a pre-processing pipeline for the [Indian Driving Dataset](#). Additionally, I fixed a bug in the IDD dataset and contributed the codebase of the pipeline's various components, which was accepted into the [IDD github repository](#).
- Developed a helmet violation detection solution intended to be used for road surveillance by the patrolling vehicles. It is based on *YOLOv4* model and achieves an mAP of 87%.

- Proposed a novel solution to detect and track triple riding violations using a trapezium regressor. For regressing the trapezium, the center and various offset coordinates were taken into account. The trapezium shaped bounding boxes were constructed over the rider-motorcycle instances, ensuring minimal overlapping. An IoU based counting algorithm was used for counting riders in the bounding box. We achieved 85% precision on a diversified test set.
- **Our work is currently under review at a top tier conference (level: A1)** .

## Bennett University

May 2019 - June 2019

Research Intern

New Delhi, India

- Worked under the guidance of [Dr. Sridhar Swaminathan](#) on a multimodal human emotion recognition system.
- Developed emotion recognition solution through *LSTM* based classifier for body language, facial landmark detection using *OpenCV* library and *Librosa* library for audio modality. Additionally, deployed the model as an Android app for real-time emotion recognition. It achieved an accuracy of 95%.
- **Our Work was accepted at IEEE BigMM 2020.**

## OTHER EXPERIENCE

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### Nayan Technologies

January 2020 - August 2020

Deep Learning and Computer Vision Intern

New Delhi, India

- Developed and deployed a cost efficient real-time traffic light recognition solution which reduced the organization's expenditure on the annotating team by 2.5 times.
- Worked on several tasks, including vehicle pose estimation, vehicle-camera distance estimation, and 2d-map vehicle trajectory estimation, all of which contributed to the development of the ADAS-based project's proof-of-concept, which was **patented** and **deployed** by **Dubai police at driving test yards throughout the UAE.**
- Spearheaded and developed several multiple deep learning projects and pipelines such as yard segmentation, lane occlusion recognition, overloaded vehicle recognition and others.

### Omdena

May 2020 - June 2020

Machine Learning Engineer

Remote

- Led a team of 10 collaborators for analysis and visualization of data gathered from Google trends for various domestic violence related terms on 10 Indian languages.
- **Successful in influencing the Ministry of Affairs to prioritize domestic violence and issue guidelines** due to the [various insights](#) gathered by the team, which were representative of various socioeconomic classes.

### NIT Kurukshetra

August 2020 - December 2020

Teaching Assistant

Kurukshetra, India

- Taught several machine learning concepts to 240 students during the semester as part of the course content. Also conducted various lab sessions and prepared it's assignments.

## PROJECTS

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### Intrusion Detection in Low Light Scenarios | Computer Vision

- Developed a video surveillance based solution for low light scenarios as a capstone project. Low-light images were processed using stacking and averaging techniques, detection of intruders and their firearms using *YOLOv4* based model, *HRNet* for intruder pose estimation, and the *Viola-Jones* algorithm for intruder face recognition.

### Eye Gaze Estimation | Deep Learning

- Worked with [Dr. Devanjan Bhattacharya](#) on the integration of *WebGazer* method with the *OpenFace* toolkit.

### Vehicle Parking Occupancy Detection | Computer Vision

- Proposed a parking occupancy status detection solution using *YOLOv3* model, homography estimation and *Point Polygon Test*. Also wrote a detailed [blog](#) on it .

### Deep Learning based COVID-19 classifier | Deep Learning

- Developed an easily deployable COVID-19 classifier which performs binary classification on X-ray images. Achieved an accuracy of 99% on the *MobileNet* model with a training set of just 50 images.

### Image Denoising with Autoencoders | Deep Learning

- Performed image denoising over *Olivetti Faces Dataset* using *Convolutional Autoencoders*.

### QuickDraw - Image Recognition | Deep Learning

- Implemented a *CNN* based image recognition tool which classifies images across 15 categories. It was inspired by Google's Quick Draw.

### Sujhav - Faculty Feedback App | Mobile App Development

- Developed and deployed A *Flutter* based Android app with *Firebase* as backend. It's use was mandated by college authorities and it aims to provide an open and transparent feedback platform for all students in the college.

## TECHNICAL SKILLS

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**Languages:** Python, C++, C, Java, Bash

**Frameworks and Libraries:** Tensorflow, Pytorch, Keras, OpenCV, NumPy, Scikit-Learn, Android Studio, ROS

**Tools:** Git, GCP, Docker, MySQL, L<sup>A</sup>T<sub>E</sub>X, HTML

**Embedded Devices:** OAK-D

## RELEVANT COURSEWORK

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**Artificial Intelligence:** Deep Learning, Image Processing, Soft Computing, Automata Theory

**Systems:** Digital System Design, Database Systems, Computer Networks, Operating Systems, Distributed Computing

**Algorithms:** Advanced Data Structures, C Programming, Principles of Programming Languages

**Mathematics:** Differential Calculus and Equations, Integral Calculus and Difference Equations, Discrete Mathematics

## ACHIEVEMENTS

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- **OpenCV AI Competition 2021:** Spearheaded team (Kurukshetra Warlords) which was shortlisted as **Finalists** among **1600 applicant teams across the world** for the proposing a visually impaired assistance solution.
- **EYRC-2019:** Led college team to the semi-finals in Eyantra 2019 competition. The project was based on application of drones in rescue and search operations.
- **Google AI Explore ML Program:** Selected as **Google AI Explore ML Facilitator** among **10k+ applicants across India**.
- **Hackshetra 2019:** Finished among **top 8 teams** from a total of 50 teams. Inspired by the happenings around various universities in India, the proposed solution was an *LSTM* based **therapeutic AI chatbot** mobile application which could converse and make the depressed users feel better.
- **Bennett University Hackathon:** Finished among **top 4 teams** from a total of 52 teams for our multimodal emotion recognition project at Bennett University.

## LEADERSHIP AND VOLUNTEERING

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- **Google AI Explore ML Program:** Successfully conducted and taught in **10 Deep Learning sessions**. These were attended by **200+ students from various backgrounds** across the university.
- **Computer Vision Webinars:** Tutored 50+ students in various webinars held during the pandemic's initial lockdown phase, where deep learning concepts such as *LSTM*, *Autoencoders*, and *Image Captioning* were taught.
- **KAIR:** Founded the first ever AI research club of the institute - Kurukshetra AI Research Club.
- **Innovation Club:** Founding member of NIT Kurukshetra's Official Innovation Club.