# Yash Khandelwal

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## Education

**Indian Institute of Technology, Kharagpur**                                    **CGPA – 8.19/10.00**

B-Tech in Chemical Engineering                                                   *July 2017 - Present*

Minor in Computer Science & Engineering

## Research Interests

▸ Deep Learning   ▸ Machine Learning   ▸ 2D/3D Computer Vision   ▸ Robotics   ▸ Multimodality   ▸ Explainability

## Publications

**Model-agnostic information biasing for Visual Question Answering** in *ACM CODS-COMAD 2021*: **Y Khandelwal**, et al. (Accepted, to appear)   **(Link)**

**Real-time Lane Detection, Fitting and Navigation for Unstructured Environments** in *International Conference of Image, Video Processing and Artificial Intelligence, Shanghai (2019)*: **Y Khandelwal**, et al**.**   **(Link)**

**A Prototype of an Intelligent Ground Vehicle for constrained environment: Design and Development** in *IEEE International conference on control and robots, South Korea (2019):* **Y Khandelwal**, et al.   **(Link)**

## Research Experience

**Wadhwani AI**                                                                  *May'20 – July'20*

*Research Intern, Advisor: Dr. Rahul Panicker*

**Aim**: To reconstruct new-born babies to correct scale using the Multiview and Geometry information   **(Link)**

- Worked on smartphone-based **anthropometry tool** that will empower health workers to screen low-weight babies
- Created a first of a kind **Multiview and Geometry model** which can reconstruct moving babies to correct shape
- Incorporated the Geometry information using a reference object, i.e., a checkerboard of fixed size in the scene.
- Deployed model brings down the **weight mae** by **26%** on the **validation set** and **14.5%** on the **test set**

**Student-teacher attention transfer in Visual Question Answering (VQA)**               *Jan'20 – Present*

*Advisor: Prof. Abir Das, Dept. of Computer Science, IIT Kharagpur*               **(Paper) (Github) (WandB)**

**Aim**: To create a model agnostic framework that improves the grounding of existing VQA models

- Proposed a student-teacher attention transfer framework for improving any existing attention-based VQA model
- Devised a novel angle-based gradient update method for simultaneous optimization of multiple objective functions
- Achieved improvement of +0.95% and +0.57% on benchmarking models MFB and BAN, using same amount of data

## Research Products

**Low-cost social distancing monitoring device**               **(Blog) (Video)** *March 2020 - May 2020*

- Developed a portable, low-cost device (total cost < $60) to monitor and encourage social distancing in crowded areas
- Implemented **~4 fps** person detection on a custom-trained **Mobilenet SSD** on a **Raspberry Pi with a rotating camera**
- Achieved an **error of 7 cms/meter** for person-to-person ground distance by using a calibrated homographic projection
- Endorsed by **Minister of Education** and covered by all major media outlets like **NDTV, Tribune, Hindustan Times,** etc.

**Face recognition-based attendance system**               **(Presentation)** *September 2019 – November 2019*

- Developed a face recognition attendance system with facilities to expand into leave and payroll management systems
- Created a face recognition model based on **MTCNN** and adjusted it for robustness on Indian faces through fine-tuning
- **Sped up** the pipeline by **~60%** by using **k-nearest neighbors** search in feature space instead of classification layers
- Deployed a **web application** to view real-time analytics about attendance and to add/remove/modify users remotely

**Autonomous Ground Vehicle Research Group**                                      *Feb'18 - Present*

*Advisor: Prof Debashish Chakravarty, Dept. of Mining Engineering, IIT Kharagpur*

- **Lane Detection and Drivable-Region Segmentation:**                            **(Video)**
  o Ideated an end to end **Deep Learning pipeline** which includes a **generator network** and a **segmentation network**
  o Designed a **Segmentation network** with **dilation and attention layers** inspired by the **U-Net and Pyramid network**
  o Experimented with models like **Embedded-Loss-GAN** and **Contextual Aggregation Network** on the **TuSimple dataset**

- **Speed Breaker Detection:**                                                    <span style="color:teal">**(Video)**</span>
  o Designed a deep learning model for real-time speed breaker detection at over **50 frames per second** on Intel i7 processor
  o Tested the model in various environmental conditions on Mahindra E20 and obtained a **test accuracy** of **92%**
  o Collected and curated a dataset of **20,000** speed breaker images using various **augmentation** techniques
- **GPS & Camera Mapping:**                                                       <span style="color:teal">**(Video)**</span>
  o Developed a **low-cost** mapping tool for efficient storage and real-time retrieval of lane markings
  o Predicted the **GPS coordinate** of a point on the ground in an image using a camera, filtered GPS, IMU, and odometry data
  o Implemented **Robot Localization package** to improve the precision of GPS data using **Extended Kalman Filter**
  o Created a 2D map of nearly 1-acre Mining Department using 2D Lidar and other sensors using **G mapping package**

## Exploratory Research Projects

### Anti-Advertisement Recommender System for Electronic Appliances                *Feb'19– July'19*
*Advisor: Prof K Sreenivasa Rao, Dept. of Computer Science Engineering, IIT Kharagpur*

- Predicted a review score using an **Aspect based Sentiment Analysis model** by taking the weighted mean of sentiments
- Analyzed the **trend and seasonality in the price** of gadget based on new launches and past behavior of similar activities
- **Scraped over 1GB** text data of product description, reviews, price, resale value, etc. from blogs, e-commerce websites, etc.

### Modelling and Optimization of Naptha Cracking Unit using Learning Methods       *Oct'18 – May'19*
*Advisor: Prof K Sudeshna Sarkar, Dept. of Computer Science Engineering, IIT Kharagpur*

- Built a **greybox model** of naphtha cracking process at the **Haldia Petrochemicals Ltd.** using process data and control logic
- Exhaustively used **IOT Techniques** and developed a **digital twin** of the plant by installing latest monitoring sensors
- Formulated **prognostic machine learning algorithms** for detection of failures using time series anomaly detection methods

## Competitions

### 27th Intelligent Ground Vehicle Competition                          <span style="color:teal">**(Design Report) (Video)**</span>
*Organized by Oakland University, Michigan USA*

- Secured the **1st position** in the qualification round and the **2nd position** in the finals of the **AutoNav challenge, 2019**
- Built a **three-wheel differential drive bot** capable of following lanes, avoiding obstacles, and reaching a set of GPS target
- Solely created an algorithm which can **identify obstacles** and **lane markings** using a **camera and 2D Lidar**
- Designed an embedded circuit with proper safety equipment and tuned the **PID parameters** for stable control of the bot

### Mahindra Rise Prize Driverless Challenge                                           **(Ongoing)**

- Part of the team which got selected amongst the **top 13 finalists** out of a total of 600 applicants from all over India
- Deployed Urban Lane Detection, Speed Breaker Detection, and Lane Mapping modules on **Mahindra E2O** electric car
- Designed an **Embedded circuit** for **battery and power management** for the sensors and computers on the car

## Awards and Achievements

- Got selected among the top 50 students in the **Google Research India AI Summer School** in the Computer Vision Track
- Awarded the **Kishore Vaigyanik Protsahan Yojana (KVPY)** fellowship by the Department of Science & Technology, India
- Awarded the 1st position in Pixelation 2018 for developing the fastest autonomous maze traversing robot

## Skills & Expertise

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|---|---|
| **Languages** | C, C++, Python |
| **Libraries** | PyTorch, TensorFlow, Keras, OpenCV, NumPy, Pandas, Selenium, WandB |
| **Frameworks** | ROS, Carla Simulator, LaTeX, Git |

## Relevant Coursework

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|---|---|
| **Computer Science** | Machine Learning \| Information Retrieval \| Scalable Data Mining \| Programming and Data Structures Theory and Lab \| Symbolic Logic \| Computer Vision \| Deep Learning (Stanford University- CS231N) |
| **Mathematics** | Linear Algebra \| Matrix Algebra \| Transform Calculus \| Numerical Solutions of Partial Differential Equations \| Probability and Statistics |