# AJAY CHANDRA NALLANI

Deep Learning Engineer – Greater Boston Area – +16124431600 – nallaniajaychandra@gmail.com

Experience in developing deep learning applications in automotive industry for over 3 years with proven success in building algorithms and predictive models for different use cases. Passionate about solving real world problems using deep learning. Graduate from Purdue university.

## Work Experience

**Aptiv** – Software Developer (Jan 2018 – present), Boston, MA

- Working in a global team to define and develop software for interior sensing features for the next generation automated driving and advanced vehicle HMI applications.
- Developed various applications for next generation vehicles using deep learning such as facial recognition, gaze region classification for driver, drowsiness detection system, left behind object detection system, activity recognition system, emotion recognition system.
- Responsible for defining ML pipeline in the group which became part of the scalable architecture.
- Lead the initiative of creating a ML runtime for various embedded platforms such as CPUs, DSPs, GPUs following automotive grade.
- Products I built made it to consumer electronics show (CES) 2018 and 2019 as part of Aptiv feature showcase. There was an incredibly positive response from clients.
- Small portion of my job responsibilities require me work as a technology scout to follow market and technical trends to guide innovation of new features for identification, position tracking, eye tracking, health monitoring and intent modelling of vehicle driver and passengers.

**Siemens Building technologies** – Project Engineer intern (Jun 2017 – Dec 2017), Buffalo Grove, IL

- Worked on 2 different projects, as a research intern and as a SharePoint administrator.
- Worked on algorithms to replace occupancy sensor with already existing sensors in the room like temperature sensor and pressure sensors. Successfully prototyped project. Was able to output not only presence of people but also number of people in the room.

**AmLED technologies** – Application Developer intern (Jun 2016 – May 2017), Itasca, IL

- Developed system and web applications to control smart lighting applications.
- Used Zigbee protocols to develop systems to control lighting at warehouse level. Some of the features developed includes turning on/off lights from a Tablet, smart adaptation of light in the warehouse using light sensor, occupancy-based activation, light failure analysis, estimation of monthly costs from lights etc.

**Bharat Heavy Electricals Limited** – Academic intern (Dec 2013 – Feb 2014), Hyderabad, India

- Completed a project on programming a FAGOR PLC on a CNC drilling machine as part of bachelors' curriculum at India's largest engineering and manufacturing enterprise.

## Projects

**Drowsiness detection system**

Camera based detection of drivers' drowsiness. A total of 74 signals like eye opening, blink rate etc., derived from the driver's camera feed were used to derive a temporal model of drowsiness classification. Different deep learning algorithms like face detection, facial landmark detection was used for this project. Implemented using both RGB and IR cameras with the help of high frequency illuminators.

**Object detector in the wild**

Regular object detector detects a predefined list of objects provided in the training set. Goal of this project is to detect any object that come into camera's field of view. Beauty of this project is it is end to end. Input is the camera feed and outputs are bounding boxes of various objects in the frame. Network is also compressed to make it run real time on a Intel NUC.

**Gaze detection system**

Goal of the project is to detect where the driver is looking at inside the vehicle cabin. This was implemented in 2 different ways. One is done end to end using a deep neural net, feed in the facial crop and the network will classify where the driver is looking at in the predefined regions like cluster, windshield etc. Other method is using the gaze of the driver in 3D space.

**3D pose estimation system using monocular camera**

A single neural network was implemented to come up with both 2D and 3D skeleton of a human. Network is not end to end. Input of the network is the camera feed and outputs are 2D and 3D heatmaps from which the 2D and 3D coordinates are derived. Point to notice is detector is estimating 3D points from monocular camera. Implemented using both RGB and IR cameras.

**1/10th Tesla Racecar project**
Did a hobby project to replicate MIT racecar project. Difference is there is no lidar being used. A set of 4 cameras and 2 Jetson Nanos are used to reconstruct the space around vehicle in 3D. Triangulation methods and different methods in Epipolar geometry are used along with previously mentioned object detector in the wild to reconstruct the scene. From SLAM, ultrasonics are used along with cameras to navigate in the scene.

**3D reconstruction of vehicle cabin**
There are a lot of limitations when reconstructing a scene. One of those limitation is that this cannot be done in real time. Camera and a stepper motor were used to get more data and less redundant data from a single camera. Triangulation methods were used to extract the point cloud. It took 7 min to process a 1 min video.

**Traffic sign detection system**
This project was done in Masters' as a capstone. Raw image data is converted to text data using Bag of visual words method. SIFT features extracted from CVC dataset of traffic signs was used to train the model. SVM was used as the classifier. A codebook of visual words with clustering of features. Then histograms of visual words for each of the training image are aggregated. These histograms are fed into classifier.

**Cognitive load in the wild**
Cognitive load detector was done end to end. This work was replicated and improvised from a paper from MIT. Eye crops are stacked to form a 3D CNN which was fed into the network to estimate the cognitive load on the driver.

## Artistry

| Deep learning | Computer vision | Machine learning |
|---|---|---|
| Supervised learning, reinforcement learning NumPy, pandas, sklearn, NLTK, PyTorch, TensorFlow | Facial analysis, pose estimation, object detection, Glance classification, emotion detection, Age and gender detection, Segmentation, Epipolar geometry, Optical flow, bag of visual words | Statistical Analysis, linear/logistics regression, clustering, graph theory, Regularizations, SVM, random forest, Decision trees, KNN |
| **Web and visualization** | **System design** | **Embedded AI** |
| Seaborn, Matplotlib, Electron JS, React JS, Three JS, Redis | Caching, MapReduce, API design | OpenVINO, TVM, SNPE |
| **Sensor fusion** | **Cross compilers / Computing platform** | **Cloud computing** |
| Cameras (Thermal, RGB, IR, TOF), Radar, Lidar, Ultrasonics | CUDA, OpenCL | Azure, Azure ML studio, Data lake |
| **Languages** | **Mathematics** | **Web crawling** |
| Python, C++, JS | Linear algebra, statistics, calculus | BeautifulSoup, lxml, Tweepy |

## Education

- **Purdue University**, Master of science, 2015-2017
  **Major**: Computer Information Technology
- **SR Autonomous University**, Bachelor of Technology, 2011-2015
  **Major**: Electronics and communication `

## Most proud of

**CES product demos**
Products I built made it to two consecutive years of CES as part of my job at Aptiv

**Robots I built**
Building robots has been a hobby

**PNW school website**
Been part of 5-member team which built the current Purdue Northwest website

**Taking on challenges**
Taking on tasks with less experience and delivering on time has been part of my regular job responsibilities

## Teaching Experience

- **Purdue University –** Teaching assistant (Jan 2016 – May 2016), Hammond, IN
  Taught 3 classes – Wireless Communications, Digital Signal Processing and Power Electronics