

COMP 491 Final Report

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COMP 491 - Capstone Prep

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This semester I have chosen to pursue working on a Convolutional Neural Network project. Computer Vision project. In conjunction with researching the topic of Computer Vision all semester long I have had the opportunity to take Image Analysis and Pattern Recognition with Professor Barber. This course has introduced me to classification, segmentation of images, and extracting data from them. This has allowed me to get hands on experience using statistical classification utilizing Naive Bayes Theorem for weak correlation and the Mahalanobis Distance for strong correlation. Along with unsupervised learning algorithms such as K-Means Clustering. The course at the end has also introduced me to the topic of Neural Networks, specifically Convolutional Neural Networks. A Convolutional Neural Network is what my goal for this project is to create. One which can be implemented and used on a live camera to detect objects that I will train for this project using a YOLO algorithm. For the object to train the model to identify, I have humans in mind but I am open to the idea of using different objects or any suggestions to focus the project on. The objects will be shown in bounding boxes with labels. The live camera would either be a stationary camera or one that is attached to a drone or RC car. If that sounds like an unrealistic goal I would be willing to do a report on the pattern recognition classification portion utilizing Naive Bayes Theorem or a Convolutional Neural Network along with the image processing and feature extraction in Python as a pivotal point if I am not making adequate progress during the milestone checkpoints. The milestones in the development process are planned as follows. Firstly, the images will be acquired and there will be preferably one thousand to ten thousand images per class minimum for a set number of classes. Following that the images will then begin the processing portion and be cleaned and segmented so that I will be provided with sufficient raw data to train my model with through the use of Python and Pytorch in VSCode on POP_OS Linux (Ubuntu-based). A sequence of first acquiring the images. Secondly, processing them through image analysis for raw data. Thirdly, Creating the Convolutional Neural Network. Fourthly, creating a confusion matrix for it. Then testing the model with testing data which does not include the training data initially used. The Final stretch of development of this project if I am able to construct an acceptable Convolution Neural Network will be writing software utilizing VSCode and Python with the Pytorch library, a YOLO algorithm, and or other machine learning libraries to use a camera and the Convolutional Neural Network model that I trained to detect the object that the model is trained for. The last part will be constructing a Capstone poster to present my project's progression at the end of the Fall Semester.

As a result the deliverability of this project will be a fully functioning Convolutional Neural Network Model. That model will be able to detect humans accurately on a live camera feed using a YOLO algorithm. It will be based on the classification process of training all of the data from the training images then testing the model with different

testing images. The resulting live feed from the camera and project will show detected humans in the camera's frame to be labeled in a bounding box on screen.

One of the reasons that this project is interesting is because we are located in Ventura County which is a hub for both agriculture and defense contractors. These are two markets in which Computer Vision and object detection play a vital role. Whether it be a drone flying over a crop to detect anomalies in produce and agriculture, or a drone flying and scouting out potentially dangerous areas, or disaster zones that need to be checked for humans, they are built on the same foundations and processes. Pattern recognition is useful in every single industry. The ability to be able to train a machine to perform tasks that we as humans do subconsciously such as identifying objects is an astonishing feat. In the past few years automata have been becoming more and more of a focus in society given that it has applicability to so many different fields and industries. On top of that, the entire process from image analysis to image segmentation and creating the data in itself is fascinating to do. Then progressing into building a model (Convolutional Neural Network in this case) and implementing it is just as intriguing. Continuing to test and improve upon these models allow for advancements and more accuracy in detecting objects such as humans. In turn this provides each industry in which it is applied to to have an accurate tool that assists them with the specified task that benefits from the model. Provided are three literature reviews that discuss similar projects to what I aim to achieve.

- [Object Detection and Localization with YOLOv3 B. Rupadevi¹, J.Pallavi²](#)
- [Blending of Learning-based Tracking and Object Detection for Monocular Camera-based Target Following Pranoy Panda, Martin Barczyk](#)
- [Human Detection Algorithm Based on Improved YOLO v4](#)

Summer 2024 Planned Learning Resources

- Professor William Barber (william.barber@csuci.edu) (CSUCI)
- [Geoff Dougherty - Pattern Recognition and Classification An Introduction Springer \(2012\)](#)
- [Deep Learning with PyTorch Step-by-Step: A Beginner's Guide: Volume I: Fundamentals](#)
- [Stephen Sturges \(Open Source AI for Drones\)](#)
- [Ultralytics YOLOv8 Documentation](#)
- [Agricultural Object Detection with You Look Only Once \(YOLO\) Algorithm: A Bibliometric and Systematic Literature Review](#)

Literature Cited

Tan, M., & Le, Q. V. (2019). EfficientNet: Rethinking Model Scaling for Convolutional Neural Networks. arXiv preprint arXiv:1901.08688.

Brownlee, J. How to Develop Convolutional Neural Network Models for Time Series Forecasting. Machine Learning Mastery. Available at: <https://machinelearningmastery.com/how-to-develop-convolutional-neural-network-models-for-time-series-forecasting/>.

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Eliot, D. Deep Learning with PyTorch Step-by-Step: A Beginner's Guide, Volume I: Fundamentals. Self-published, 2020.

YOLOv8 Documentation. Available at: <https://docs.ultralytics.com/models/yolov8/>.

Jocher, G., Chaurasia, A., & Qiu, J. (2023). Ultralytics YOLOv8. Available at: <https://github.com/ultralytics/ultralytics>.