

Felon Prediction with CNN Variants

Leo Q, Zachary R, Aadarsh S, Tahmeed Z

Mentor: Dr. Nouhad Rizk

Department of Computer Science, University of Houston

Abstract

Convolutional Neural Networks are very powerful tools for facial recognition. There has been a lot of work done in the realm of classification based on emotion and other facial qualities. One of the major issues with this technology is the bias of machine learning with regards to its use in law enforcement. This can result in a disproportionate increase in poor policy and arrests affecting minority groups. The purpose of this study was to find whether substantial evidence exists of a correlation between one's facial features and whether someone is a felon or not. Using different variants of CNN, as well as an implementation of SVM, models of varying quality were used to test for this correlation. The best model was the InceptionV3, with an accuracy of 73%, leading to the conclusion that there are possible applications when done ethically and accurately.

Background

Convolutional Neural Network's (CNN) develop a feedback loop that promotes racist survelliance and consequentially, a disproportionate increase in poor policy and arrests affecting minority groups. The New York Police Department database of 42,000 "gang affiliates" – 99% Black and Latino led to harsher sentencing, higher bails, and the denial of bail altogether. [5]

Work on felon classification using CNN is extremely limited, but work has been done in classifying faces by emotion. This has been applied with high accuracy results, as well as being applied in important settings such as natural disaster relief.

Methods

The most basic model used was a standard CNN model with three convolution layers, two max pooling layers, and two dense layers. This is the simplest model to be implemented and acts as a good baseline.

We challenged our basic CNN Model with a Dropout Method which reduced data-overfitting by removing 20% of the image training-set at each epoch. In our model of 10 epochs, we received a total prediction accuracy of 50%.

We utilized Keras Tuning to find the highest prediction accuracy parameters for our basic CNN model. Our specific focus being on the optimal units per hidden layer. No significant prediction improvement found after 8 units when testing units 0 up to 32.

Non-neural network models such as SVM was implemented using hyperparameter tuning with a RandomizedSearchCV to find the optimal hyperparameters and classify the data through segregation.

The 4th model utilized was InceptionV3, a 48 layer based CNN model. It is a computationally inexpensive model that is pre-trained and has been improved upon from previous inception models. This model yielded us an accuracy of 73.91%.



Results

The results from our CNN models were compared to variations of Neural Network Models such as Support Vector Machine (SVM), Keras Tuning, and InceptionV3. Based on the results obtained from our models, it is evident that the best model was InceptionV3 because the test accuracy hovered around the highest range for this model from 63 to 75% with the peak being 73.91% compared to only around a 50.17% accuracy for SVM, 50% for the CNN model with and without dropout, and 50.1% for Keras Tuning. However, in terms of training accuracy of the models, SVM was the highest with a 68.9% accuracy compared to 50.2% for CNN and Keras tuning, 51.4% for inception, and 59.8% for InceptionV3.

Conclusion

It can be concluded based on the results that inception V3 yielded as the best model. It had the highest test accuracy at 73.91 %. Alongside this, Inception v3 is a rather computationally inexpensive model to build/run.

Future Direction

The overall accuracy results with deep learning techniques are not as impressive as expected To expand upon dataset, a larger and more diverse dataset can be used. In addition, we need to be careful of overfitting and continue work with application of more models

Acknowledgments

Acknowledgements include Dr. Nouhad Rizk, Medium, BioMed Central, IEEE ICDSCA, IEEE ICCSP, I3CA, Harvard, Analytics Vidhya, and ICCS.